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BIOLOGY OF APHODIINAE WITH SPECIAL REFERENCE TO OREGON

(Coleoptera: Scarabaeidae)

Manohar Lal Jerath and Paul O. Ritcher

Oregon State College, Corvallis

Our knowledge of the biology of the subfamily Aphodiinae is still rather fragmentary. Such information as is now available relates only to a few of the known species (Mulsant, 1842, 1871; Xambeau, 1890; Cabanes, 1920; Madle, 1934; Hoffman, 1935; Martyn, 1956; Ritcher, 1958).

Tribe Aegialiini

Species belonging to this tribe have been described since 1787, but so far no one has reported on the biology of the group. We have collected several species under vegetation on sand dunes at the Oregon coastal beaches and also in sandy areas along inland streams.

At Waldport, Oregon, *Aegialia blanchardi* Horn was collected throughout the year from 1955 to 1957, inclusive. This species was collected by sifting sand around and beneath the roots of vegetation on the dunes. Apparently there is only one generation a year because larvae and pupae were found only during early summer from May 29 to July 16. Usually they were at a depth of approximately 6 to 8 inches below the surface. At this depth, the temperature ranges from 50° to 60° F. throughout the year. Adults were present throughout the year just below the surface.

Temperature seems to have some effect on the length of the pupal stage within the range of 60° F. to approximately 70° F.; it has considerable effect on mortality. On June 12, 1956, more than 200 third-stage larvae of *Aegialia blanchardi* Horn were collected at Waldport, Oregon. One group of 20 larvae, each in a separate salve box, was kept at room temperature. These larvae pupated in two to four days and the pupal stage lasted for 12 to 15 days, but the mortality was 60%. Another group of 20 larvae, each in a separate salve box, was kept at 60° F. These larvae pupated seven to 10 days later and the

pupal stage lasted for 15 to 19 days. The mortality in this group was only 10%.

At Kiger Island, five miles southeast of Corvallis, Oregon, on May 27, 1957, numerous second and third-stage larvae and adults of *Aegialia* spp. were collected in sand drifts under willows, by sifting the sand. (Dr. O. L. Cartwright of the U.S. National Museum identified the adults as *Aegialia blanchardi* Horn, *A. lacustris* LeConte, *A. latispina* LeConte, and *A. nigrella* Brown). Eight trips were made from May 27, 1957 to September 15, 1957, but no larvae were found on either August 15 or September 15, 1957. Pupae were found as early as June 17, and as late as August 15, 1957. Examination of the fore gut contents showed that the larvae were feeding only on decaying organic matter.

The above information indicates that the species of the genus *Aegialia* apparently have one generation a year and the adults over-winter. The adults probably lay eggs in spring, and the larval stage lasts till the third week of July. Newly transformed adults were numerous during late July and August. Examination of the ovaries of the females during August and September showed no egg development.

Tribe Aphodiini

Food Habits and Economic Importance: The members of this tribe are commonly found in dung all over the world. Species have been reported to occur in deer, cow, horse, sheep, human, elephant, rat, and other animal manure. Eight species, however, have been found to feed on live roots of plants. Four are parasitic and one feeds on decaying leaves. Two species seem to be myrmecophiles.

Lugger (1899) observed larvae of *Aphodius granarius* (Linnaeus) eating the sprouting seeds of corn in Minnesota. In Oregon, larvae of A. *granarius* have been found in the soil where they may have been feeding on grass roots. Downes (1928) in British Columbia and Ritcher and Morrison (1955) in Oregon, reported larvae of *Aphodius pardalis* LeConte feeding on golf turf and doing considerable damage.

Swan (1934) and Carne (1950) recorded *Aphodius howitti* Hope (= *A. tasmaniae* Hope) destructive to pastures in the southeast portion of Australia and Tasmania. Van Emden (1941) records larvae of *Aphodius fimetarius* (Linnaeus) being noxious on potatoes at Bremen, Germany, and larvae of *Aphodius contam-*

inatus Herbst were collected in a golf course. In England, adults of *A. fimetarius* and *Aphodius subterraneus* (Linnaeus), which are common in horse manure, have been reported to injure mushrooms by devouring portions of the caps (Anonymous, 1944).

Martyn (1956), in Tasmania, worked out the distribution in relation to climate of *Aphodius howitti* Hope and *Aphodius pseudotasmaniae* Given. According to him, the larvae of these species feed on pasture plants.

Aphodius larvae were collected injuring mint roots at Quincy, Washington, on July 27, 1955 by C. H. Starker. Adults reared from these larvae were identified by O. L. Cartwright as *Aphodius distinctus* Müller. Larvae later identified as *Aphodius hamatus* Say were found injuring the turf in pastures in Ruby Valley, Nevada, by R. W. Lauderdale.

Chapman (1870) noted *Aphodius porcus* (Fabricius) parasitizing the egg of *Geotrupes stercorarius* (Linnaeus). Howden (1955) found *Aphodius lividus* (Olivier) and *Aphodius rubeolus* Beauvois parasitizing and developing in the egg cell of *Phanaeus* and *Onthophagus medorensis* Brown. Howden is of the opinion that *Aphodius* larvae destroy and may consume the eggs or larvae of the host.

Larvae of *Aphodius* sp. were collected in a *Formica* nest at a locality eight miles east of Silver Lake, Oregon, on May 16, 1957. These larvae were found in the dry upper part of the nest, with the ants, but were not being bothered by the ants. Mann (1911) collected eight adults of *Aphodius suspectus* Mann, on bait, from a *Formica* nest at Pullman, Washington.

Adults of *Oxyomus silvestris* (Scopoli) have been recorded to occur in dung in Europe, Schmidt (1911). Larvae loaned to the writers by the U.S. National Museum were collected in the soil around roses at Luxemburg on May 24, 1949.

Length of Life Cycle: According to Madle (1934), *Aphodius fimentarius* (Linnaeus) and *Aphodius depressus* Kugel have two generations a year and *Aphodius fossor* (Linnaeus) and *Aphodius rufipes* (Linnaeus) have a single generation a year in Dresden (Germany). There, *A. fimetarius* and *A. depressus* overwinter as larvae, whereas *A. fossor* and *A. rufipes* may overwinter as larvae which pupate in spring. *A. rufipes* and *A. fossor* may overwinter as adults, if the conditions are favorable in early fall. Also, in Germany, *Aphodius alpinus* (Scopoli) over-

winters as larvae and *Aphodius prodromus* Brahm overwinters as adults.

Most members of this tribe, in Oregon, have one generation a year. According to the writers' observations, *Aphodius fimetarius* (Linnaeus), *Aphodius granarius* (Linnaeus), *Aphodius pectoralis* LeConte, *Aphodius sparsus* LeConte, and *Aphodius aleutus* (Eschscholtz) have one generation a year. *Aphodius vittatus* Say appears to have two generations a year in Oregon. *A. fimetarius*, *A. granarius* and *A. vittatus* overwinter as adults, whereas *A. sparsus* and *A. aleutus* overwinter as mature larvae.

According to van Emden (1941), the larvae of lamellicornia moult thrice, the third ecdysis releasing the pupa. The writers have also found only three instars of *Aphodius* larvae.

Tribe Eupariini

Of the tribe Eupariini, biological information is available only for *Ataenius cognatus* (LeConte), Hoffman (1935). Brief notes on the habitats for some members of this tribe are given by Cartwright (1944, 1948, and 1952) in his papers on adults.

Hoffman (1935) states that the larvae of *Ataenius cognatus* (LeConte)[1] infest golf courses in Minnesota. The adults in Minnesota overwintered, and there was one generation a year. According to him, the beetles were taken in light traps as early as May 1, but the females oviposited in late May or June. The length of pupal period in the laboratory was 8.7 days. On September 1, on digging in the golf course, no larval stages were found, but the beetles were hiding in waste piles of grass.

Adults and larvae of *Ataenius spretulus* (Haldeman) were collected and reared in cow dung by Paul O. Ritcher at Lexington, Kentucky during 1944.

Adults of *Ataenius saxatalis* Cartwright were collected in South Carolina in sand washed down to the edges of pockets or islands of soil and vegetation on outcroppings of bare weathered areas of granite or rocks, or in the sand or soil around the lower edges or such areas of rock (Cartwright, 1944).

Adults of *Ataenius fattigi* Cartwright were collected in South Carolina under leaves, twigs and surface litter along paths on hard ground in woodlands. Two adults were taken under dry

[1] According to O. L. Cartwright in a letter dated September 22, 1955, the species with which Hoffman was dealing could be *Ataenius spretulus* (Haldeman).

cow dung in a burned-over woods and a few more taken in light traps (Cartwright, 1948).

Adults and larvae of *Euparia castanea* Serville are recorded occurring in ant nests (Schmidt, 1911). According to Horn (1887), this species occurs in Florida, Alabama and Louisiana in the nests of a small ant (species not given).

Adults and larvae of *Saprosites* are found under the bark of trees (personal communication from O. L. Cartwright). Adults and larvae of *Aphotaenius* are common in cow and deer droppings in North Carolina from April 29 to September 10 (Cartwright, 1952).

Tribe Psammodiini

In Oregon, adults and larvae of *Psammodius* spp. have only been collected at the coastal dunes, under vegetation. In other parts of the United States, species of *Psammodius* have been collected along inland streams (Cartwright, 1955).

Adults and larvae of *Psammodius oregonensis* Cartwright were found throughout the year, at Waldport, Oregon, under vegetation. Larvae were found in the sand, six to eight inches below the surface, where the temperature ranged from 55-60° F. Adults were found just beneath the surface. Examination of the fore-gut contents of the larvae showed live plant tissue, indicating they feed on the roots of vegetation. Pupae and numerous newly transformed adults were collected during August and September.

On September 5, 1957, a trip was made to sample the coastal area from Oceanlake northwards to a point eight miles south of Astoria, Oregon. A great many adults and larvae (second and third-stage) were collected at numerous points along this area. They were common at a distance of about half a mile away from the ocean.

Adults of *P. oregonensis* from Waldport, Oregon, did not lay eggs in captivity even though eggs were in the ovaries. The length of pupal stage at room temperature was found to be from 10 to 12 days, but the mortality was very high. At 60° F. third-stage larvae pupated in 60 to 80 days after they were brought from the coast with the pupal stage lasting for 10 to 15 days. The mortality at 60° F. was about 8%.

Adults and larvae of *Pleurophorus* have been recorded occurring in soil or in dung (Mulsant, 1842). Larvae of *Pleurophorus caesus* (Creutzer) were collected in soil around roots of *Zinnia*

plants by J. B. Steinweden and P. C. Ting in an evergreen nursery at San Francisco, California, on June 11, 1934. Adults emerged on June 30, 1934.

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HESPEROCIMEX COLORADENSIS LIST IN OREGON

(Hemiptera: Cimicidae)

JOHN D. LATTIN[1] AND JOE SCHUH[2]

The junior author collected a series of *Hesperocimex coloradensis* List from an abandoned woodpecker nest at Prairie City, Grant County, Oregon, on April 25, 1959. This nest was in a fallen poplar tree and would have been approximately 25 feet

[1]Department of Entomology, Oregon State College, Corvallis, Oregon (Supported in part by General Research Fund, Oregon State College).
[2]Klamath Falls, Oregon.

from the ground. It was filled with dry blades of grass and contained in the neighborhood of 300 immature and adult bugs. These specimens agreed in all respects with the original description with the following exceptions: total length varied from 3.8–4.3 mm. as opposed to 3.3–3.8 mm; total width varied from 2.45–2.9 mm. as opposed to 2.1–2.6 mm. (the latter measurements in both cases were those cited in the original description); metasternum almost truncate posteriorly, lightly sinuate medially; anterior margin of pronotum almost straight. The differences in measurements may be attributed to the fact that the specimens were collected into alcohol and became somewhat distended. All other measurements of the various portions of the body less susceptible to expansion agreed with the original description in every way.

List (1925, Proc. Biol. Soc. Wash., 38:104), proposed a new genus, *Hesperocimex*, at the same time as he described *coloradensis* (*loc. cit.*, 104), to contain this new species. *Hesperocimex* may be distinguished from other cimicids occurring in the Pacific Northwest by the short beak (not reaching beyond the front coxae); triangular metasternum; rounded posterior margin of the scutellum and the non-reflexed lateral margin of the pronotum. *H. coloradensis* is generally considered a rare species, known previously from Colorado, Nebraska, California and Mexico. It is associated with the Purple Martin.

Prairie City is located in east-central Oregon in the southwestern foothills of the Blue Mountains at an elevation of 3,546 feet. This area contains certain elements of the Rocky Mountain fauna that extend in a southwesterly direction along the tops of the Wallowa and Blue Mountains. This species should be recovered from other localities within the state of Oregon.

The discovery of this species of cimicid brings the total to four species known to occur in Oregon; *Cimex lectularius* Linneaus, fairly common throughout the state; *Cimex pilosellus* (Horvath) on *Myotus*, known from only three localities in the state but concentrated collecting should prove it to be common wherever bats occur; *Oeciacus vicarius* Horvath, associated with swallows from several localities in the state, also should be rather widely distributed; and *Hesperocimex coloradensis* List. Close attention to cimicids occurring with bats and birds may disclose additional species for this region.

JAPYGIDAE OF NORTH AMERICA 2. THE GENUS HOLJAPYX AND DESCRIPTIONS OF NEW SPECIES

Leslie M. Smith
University of California, Davis

The genus *Holjapyx* was established by Silvestri (1948) to contain the single American species *diversiunguis*. This species was originally described as *Japyx diversiunguis* by Silvestri in 1910. No other species of this genus have been described to date from America. Pagés (1952) described ? *H. forsteri*, ? *H. forsteri archeyi*, and ? *H. punamuensis* from New Zealand but was doubtful that these species were properly assigned to *Holjapyx*. *H. forsteri* has 28 segments in the antennae, *H. punamuensis* has 33, and males of both species are without male sacs in the third and fourth abdominal segments. Further study of New Zealand japygids may establish their proper generic relationship. Paclt (1957) placed *Holjapyx* as a synonym of *Burmjapyx* Silvestri (1930). After studying the nine new species presented in this paper, I conclude that the genus *Holjapyx* is distinct from *Burmjapyx*.

Genus Holjapyx Silv. 1948, emend. L. M. Smith

Antenna with 26 segments, trichobothria subequal to M[1] on the same segment, terminal segment lanceolate, longer than wide with three placoid sensillae. First lamina of lacinia pectinate with five to ten teeth; a small spine between lamina three and four. Lateral subcoxal organs with one to four rows of long glandular setae and one row of shorter and much thinner sensory setae. Median subcoxal organ area wrinkled, without disculi or setae, except 2+2 minute setae at a 45° angle to mid-line. Styli with a distinct secondary cone, Sr = 0.25–0.38. Male (in most species) with a median ventral sac opening on the scutum of abdominal segments III and IV, each containing one to ten minutely plumose small setae directed toward the posterior. Postero-lateral angles of tergite VII obtuse, right, acute, or projected to rear as lobes. Segment X, W:L = 0.95–1.13, one or two median M. Acropygidium small, rounded. Rectum visible through tergite X with an irregular row of internal, short, stout setae directed posteriorly on each side of rectum eight to 28 setae per row.

Forceps: R=0.371–0.541, one prominent tooth on each forcep, predental tubercles of left forcep always biserrate, predental tubercles of right forcep usually uniserrate, but in some species biserrate. Post-dental margins of both forceps crenulate or smooth. Genital orifice of male ringed anteriorly with one row of extremely small setae and posteriorly with

[1] Abbreviations: M—macrosetae; m—submacrosetae; R—x/y, see fig. 20; x—distance from tooth to tip of left forcep; y—distance from basal articulation to tip of left forcep; Sr—ratio of length of secondary cone of stylus VII to length of stylus.

one row of 12 larger setae, genital papillae conical, as wide as long, each with about 45 setae, mostly on the mesad side. Genital orifice of female not ringed with setae, two short anterior papillae three times as wide as long and one pair of larger posterior papillae as wide as long; all papillae with normal setate and a few very short sense setae; on each side of the genital opening a small, slightly raised area with 5–10 short sense setae close together.

Type species: *Holjapyx diversiunguis* (Silv.). This genus is close to *Occasjapyx* but differs from it in the presence of five pectinate laminae on the lacinia, a single large tooth on each forcep, two more segments in the antennae, and setae in the rectum.

Holjapyx calaverasae L. Smith, new species

Female.—*Head* dorsum with about 12 + 12 M and 15 + 15 m, antennae typical, mandible with four distinct teeth, fifth, basal tooth indicated by small hump, inner surface of labrum with 11+11 similar, short, stout setae, outer surface of labrum with 26+26 setae of various sizes, first lamina of lacinia with four teeth, maxillary palpus with 12 setae, thumb of galea with nine sensory cones, tip of glossa of labium fringed with 23 setae, labial palpus W:L=0.46, with 6 M and 3 m. *Thorax*, pronotum prescutum 1+1 M and 1+1 m, scutum 4+4 M and 6+6 m, mesonotum prescutum 1+1 M and 1+1 m,scutum 5+5 M and 11+11 m, metanotum prescutum 1+1 M and 1+1 m, scutum 5+5 M and 11+11 m. Legs long, leg III 2.34 times length of forcep, dorsal apex of femur with a transverse row of five setae; large ventral setae per row on tarsus, 4. *Abdomen*, tergite I 3+3 M and 10+10 m, tergite II 4+4 M and 16+16 m, tergites III–VII 7+7 M and about 18+18 m, postero-lateral angles of tergite VII obtuse, not lobed, tergite VIII 5+5 M and about 14+14 m, tergite IX 3 + 3 m, tergite X 2 + 2 + 2 M and 11+11 m, carinae not sclerotized, setae in rectum about 15; pleura II–VII pleurite 1 m, pleuron 1 M and 6–8 m, sternum I apotome 3 + 3 M and 5 + 6 m, scutum 13+13 M and about 30+30 m, lateral subcoxal organs one-third as broad as distance between styli; two rows glandular setae about 60+60 and one row sensory setae 30+30, median subcoxal area typical, sternum II apotome without setae, scutum 17 + 17 M and 17 + 17 m, sterna III–VII similar to II, sternum VIII 7+7 M and 12+12 m, sternum IX 2+2 M and 3+3 m, sternum X 10+10 M and about 20+20 m, genitalia typical, sense setae on anterior papillae 2+3, sense setae clusters laterad of genital pore 7 + 7, sense setae on posterior papillae 3 + 3, Sr=0.83. *Forceps*, Left arm with one tooth, R=0.371 tooth distinct, not fused with postdental margin, predental tubercles 5/6 upper row a cluster of four basally (some specimens 4/5), and one distal removed, postdental margin curved, smooth with three faint denticles; right arm with one tooth, predental margin with two monoserrated denticles, postdental margin with eight obscure denticles basally.

Male.—Similar to female except: six very small setae mesad in

median subcoxal area, male sacs in III and IV without setae, Sr=0.32, median subcoxal organs with three rows glandular setae, setae in rectum 17, R=0.371, left arm forceps postdental margin smooth, curved, right arm forceps, postdental margin crenulate, curved.

Holotype female, one male paratype, seven female paratypes, and one juvenile, TWO MILES WEST OF SAN ANDREAS, CALAVERAS COUNTY, CALIFORNIA, March 25, 1958 (L. M. Smith and R. O. Schuster), altitude 1,000 feet, sandy clay loam soil, pH 8, 20° slope, under *Quercus wislizenii.*

Holotype female and paratype male in California Academy of Sciences; paratype females in the California Insect Survey, U.S. National Museum, and University of California, Davis.

Holjapyx schusteri L. Smith, new species

Female.—Similar to *H. calaverasae* L. Smith, except: first lamina of lacinia with 11 teeth, tip of glossae with 26–28 setae, labial palpus W:L=0.50 with 6 M and 2 m, dorsal apex of femur with a transverse row of four setae, tergite I 3+3 M, tergite II 5+5 M and 14+14 m, tergite IX 1+1 M and 2+2 m, tergite X 2+1+2, setae in rectum about 30, faintly plumose, postero-lateral angles of tergite VII acute, not lobed, sternum I scutum about 15+15 M, one row of 11+11 uniform m immediately anterior to lateral subcoxal organs, lateral subcoxal organs and median subcoxal organ each occupying 0.14 of the distance between styli, lateral subcoxal organs with 2–5+2–5 glandular setae in one row and one row of 10+10 sensory setae, one-third as long as glandular setae, sternum IX 3+3 M and 3+3 m, sense setae clusters laterad of genital pore 8+8, sense setae on posterior genital papillae 4+5, Sr=0.32.

Forceps, left arm with one tooth, R=0.385, tooth distinct, not fused with postdental margin, predental tubercles 6/7, postdental margin curved with 11 crenulations; right arm with one tooth, predental tubercles 1/2, postdental margin curved with 14 crenulations.

Male.—Similar to female except: labial palpus with 5 M and 4 m, lateral subcoxal organs with 2+2 large glandular setae (one specimen 3+4) and 8+9 small sensory setae, male sacs in III and IV not visible; genital orifice anterior plate with irregular arrangement of about 20 long setae, anterior to pore 21 very small irregularly arranged glandular setae, posterior to pore a regular row of 10 medium setae, posterior plate with about 40 large setae, genital papillae W:L=0.31 with about 20 setae, laterad setae twice as long as mesad setae, and one group of three very short sense setae laterad and one such seta near the tip, forceps as in female, R=0.427.

Holotype female, 1♂ paratype, 1♀ paratype, and 1♀ juvenile, ONE MILE WEST OF SAN ANDREAS LAKE, SAN MATEO COUNTY, CALIFORNIA, November 1956, November 1957, and January 1957, in soil, open grassland and under live oak (D. W. Price), and

1♂ collected by Mr. G. A. Marsh on Mount Diablo, Contra Costa County, California, February 15, 1953. Holotype and paratype ♂ in California Academy of Sciences; paratype ♀ and ♂ in U.S. National Museum.

I take pleasure in naming this species after Mr. Robert O. Schuster.

Holjapyx humidus L. Smith, new species

Female.—Similar to *H. calaverasae* L. Smith, except: first lamina of lacinia with 8–10 teeth, thumb of galea with 15 minute setae, tip of glossa of labium tipped with 32 setae, labial palpus W:L=0.47 with 10 M and 2 m, mesonotum and metanotum prescutum 1+1 M and 2+3 m, dorsal apex of femur with a transverse row of six setae, abdominal tergite I 2+2 M and about 15+15 m, setae in rectum 46 not visibly plumose, postero-lateral angles tergite VII acute but not lobed, sense setae on posterior genital papillae 4+4, tergum X 2+2+2 M, sense setae clusters laterad of genital pore 14+14, Sr=0.29. Forceps: R=0.454, left predental tubercles 5/7 upper row not grouped, no postdental tubercles.

Male.—Similar to male of *H. calaverasae* L. Smith, except: male sac III with about 16 bilaterally plumose setae, male sac IV with about 12 similar setae, Sr=0.27, setae in rectum 25, R=0.500, left forcep predental tubercles 6/7.

Holotype female, MENDOCINO, MENDOCINO COUNTY, CALIFORNIA, December 25, 1958, and paratype male same locality June 1, 1954 (J. R. Helfer). Both deposited California Academy of Sciences, San Francisco.

Holjapyx hyadis L. Smith, new species

Female.—Similar to *H. calaverasae* L. Smith, except: labial palpus W:L=0.40, with 6 M and 4 m, thorax mesonotum prescutum 1+1 M and 2+2 m, mesonotum, prescutum 1+1 M and 2+2 m, dorsal apex of femur with a transverse row of six setae, setae in rectum not visible, tergite I 2+2 M, tergite X 2+1+2 M lateral subcoxal organ with one irregular row of 25+25 long glandular setae and one row of 25+25 small sensory setae, sense setae on genitalia not visible, Sr=0.30, forceps: R=0.455.

Male.—Similar to male of *H. calaverasae* L. Smith except: first lamina of lacinia with six teeth, labial palpus W:L=0.36, dorsal apex of femur with a transverse row of six setae, median subcoxal organs with two rows glandular setae, male sacs in III and IV each with one simple seta, Sr=0.31, setae in rectum not visible, R=0.450, forceps left arm predental tubercles 5/5.

Holotype female and allotype male. KINGS MOUNTAIN, SAN MATEO COUNTY, CALIFORNIA, December, 1957 (D. W. Price). Kings Mountain is four miles north of Lahonda. The specimens were found in deep humus of redwood, madrone, and tan bark oak. The area probably remains moist throughout the year.

Holotype and allotype deposited in the California Academy of Sciences.

Holjapyx conspersus L. Smith, new species

Female.—Similar to female of *H. calaverasae* L. Smith except: labial palpus W:L=0.33 with 6 M and 6 m, pronotum scutum 4+4 M and 9+9 m, mesonotum prescutum 1+1 M and 2+2 m, dorsal apex of femur with transverse row of six setae, postero-lateral angles of tergite VII distinctly lobed, abdominal tergite I with 2+2 M, tergite X 2+1+2 M and about 11+11 m, carinae sclerotized, setae in rectum 17, lateral subcoxal organs with two rows of glandular setae, about 70+70, sense setae clusters laterad of genital pore 8+8, Sr=0.29; forceps R=0.474, tooth left arm fused with postdental margin, predental tubercles 6/8 upper row three large denticles proximal and three smaller denticles distal.

Male.—Similar to male of *H. calaverasae* L. Smith except: small setae absent in median subcoxal area, male sac III setae obscured, male sac IV with four small setae, minutely plumose, Sr=0.36, median subcoxal organs with two rows of glandular setae, setae in rectum obscured; forceps: R=0.467, left arm predental tubercles 3/5.

Holotype female and allotype male, THREE MILES NORTH OF SHARP PARK, SAN MATEO COUNTY, CALIFORNIA, February, 1958 (D. W. Price) in humus under chaparral, especially coffee berry, christmas berry, coyote brush and scrub oak. Holotype and allotype deposited in the California Academy of Sciences.

Holjapyx imbutus L. Smith, new species

Male.—Similar to male of *H. calaverasae* L. Smith except: trichobothria two-thirds as long as longest seta on same antennal segment, labial palpus W:L=0.40 with 6 M and 4 m, mesonotum prescutum 1+1 M and 2+2 m, setae per transverse row on dorsal apex of femora: leg 1 and 2, five each, leg 3, six; postero-lateral angles of tergite VII right-angles, tergite I with 3+3 M, tergite X 2+2+2 M, lateral subcoxal organs occupy 0.76 of distance between styli, three rows glandular setae, about 90+90, lateral genital papillae each with about 20 large setae mainly lateral, and a compact mass of about 35 setae mesad, male sac in III with three curved plumose setae, male sac in IV with one curved plumose seta, Sr=0.30, setae in rectum 19, R=0.438, forceps left arm predental tubercles 6/3 (others 4/4 and 6/7) tooth distinct, postdental margin straight, smooth, right arm predental tubercles typical, postdental margin straight with three distinct denticles near tooth and crenulations distad.

Female unknown.

Holotype male, ONE MILE NORTH OF MURPHYS, CALAVERAS COUNTY, CALIFORNIA, March 5, 1958 (L. M. Smith and R. O. Schuster), in humus under oak tree. Paratype ♂ and one juvenile, three miles west of San Andreas, Calaveras County, California, March 25, 1958 (L. M. Smith and R. O. Schuster), in wet humus

and soil; paratype ♂, Calaveras Big Trees, Calaveras County, March 5, 1958 (L. M. Smith and R. O. Schuster), in rotten redwood log, soil temperature 3" deep 4°C.

Holotype male in California Academy of Sciences, paratype males in the California Insect Survey and University of California, Davis.

Holjapyx insiccatus L. Smith, new species

Female.—Similar to *H. calaverasae* L. Smith except: 1st lamina of lacinia with seven teeth, maxillary palpus with 12 setae and two minute sensory cones at the apex, labial palpus W:L=0.23 with 6 M and 4 m, mesonotum and metanotum prescutum 1+1 M and 2+2 m, dorsal apex of femora with a transverse row of six setae, abdominal tergite I 2+2 M and 12+12 m, postero-lateral angles of tergite VII right angles, tergite X 2+1+2 M, carinae sclerotized, setae in rectum 26, simple, lateral subcoxal organs with three rows glandular setae, Sr=0.30, forceps, left arm predental tubercles 7/6, strongly developed, uniformly spaced, R=0.467, right arm predental tubercles two, postdental margin crenulate with 13 crenulations visible.

Male unknown.

Holotype female and paratype female, NINE MILES SOUTH OF MONTICELLO, NAPA COUNTY, CALIFORNIA, December 13, 1957 (L. M. Smith and R. O. Schuster), on grassy slope under stones, one juvenile same locality May 12, 1957 (L. M. Smith and R. O. Schuster).

Holotype ♀ in California Academy of Sciences, paratype ♀ in the California Insect Survey.

Holjapyx irroratus L. Smith, new species

Female.—Similar to *H. calaverasae* L. Smith except: maxillary palpus with 15 setae and two minute sensory cones at the apex, thumb of galea with 15 sensory cones, tip of glossa of labium fringed with 27 setae,

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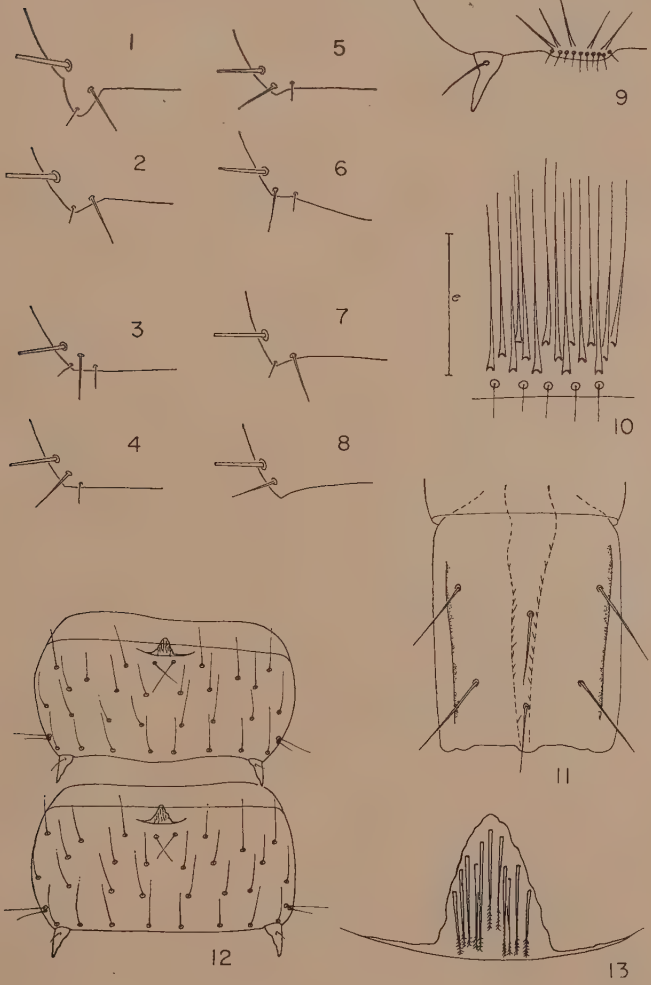
EXPLANATION OF FIGURES

Figs. 1–8, postero-lateral angles of seventh abdominal tergite: (e=0.50 mm.) 1. *Holjapyx conspersus* ♀, 2. *H. diversiunguis* ♀, 3. *H. humidus* ♀, 4. *H. madidus* ♂, 5. *H. irroratus* ♀, 6. *H. calaverasae* ♀, 7. *H. insiccatus* ♀, 8. *H. schusteri* ♀, 9. lateral subcoxal organ *H. schusteri* ♀ showing five glandular setae and ten sense setae, 10. small portion of lateral subcoxal organ of *H. humidus* ♂ showing three rows of glandular setae and one row of sense setae (e=0.054 mm.), 11. dorsal view of tenth abdominal tergite of *H. irroratus* ♀ showing 2+2+2 M and rectal setae (e=0.50 mm.), 12. ventral view of third and fourth abdominal sternites of *H. humidus* ♂ showing male setose sacs (e=0.50 mm.), 13. Male setose sac from fourth abdominal segment of *H. humidus*.

labial palpus W:L=0.34 with 6 M and 4 m, dorsal apex of femur with transverse row of six setae, abdominal tergite I 2+2 M and 10+10 m, postero-lateral angles of tergite VII acute, not lobed, tergite X 2+2+2 M, carinae sclerotized, setae in rectum 25, median subcoxal area slightly wider than either lateral subcoxal organ, lateral subcoxal organs with one row glandular setae 22+22, one row sense setae 25+25, sense setae



clusters laterad of genital pore 9+10. Sr=0.27, forceps left arm R=0.413, predental tubercles 6/6, postdental margin nearly smooth, curved, right arm tooth distinct, postdental margin with 10 visible crenulations.

Male unknown.

Holotype female and paratype female, ARMSTRONG STATE PARK, SONOMA COUNTY, CALIFORNIA, March 14, 1954 (J. Helfer), in humus under redwood trees. Holotype ♀ in California Academy of Sciences, paratype ♀ in the California Insect Survey.

Holjapyx madidus L. Smith, new species

Male.—Similar to *H. calaverasae* L. Smith except: outer surface of labrum with 19 setae, labial palpus W:L=0.34, with 6 M and 2 or 3 m, mesonotum prescutum 1+1 M and 2+2 m, abdominal tergite I 2+2 M and 10+10 m, male sacs in III with two plumose setae, IV with one similar seta, postero-lateral angles tergite VII obtuse, not lobed, carinae sclerotized, setae in rectum 15, sternum I apotome 3+3 M and 2+2 m, lateral subcoxal organs with one row glandular setae, 24+24, Sr=0.37, forceps left arm, R=0.532, predental tubercles 4/4, tooth fused with postdental margin, postdental margin smooth, curved, right arm predental tubercles 1/1, postdental margin slightly crenulate, curved.

Female unknown.

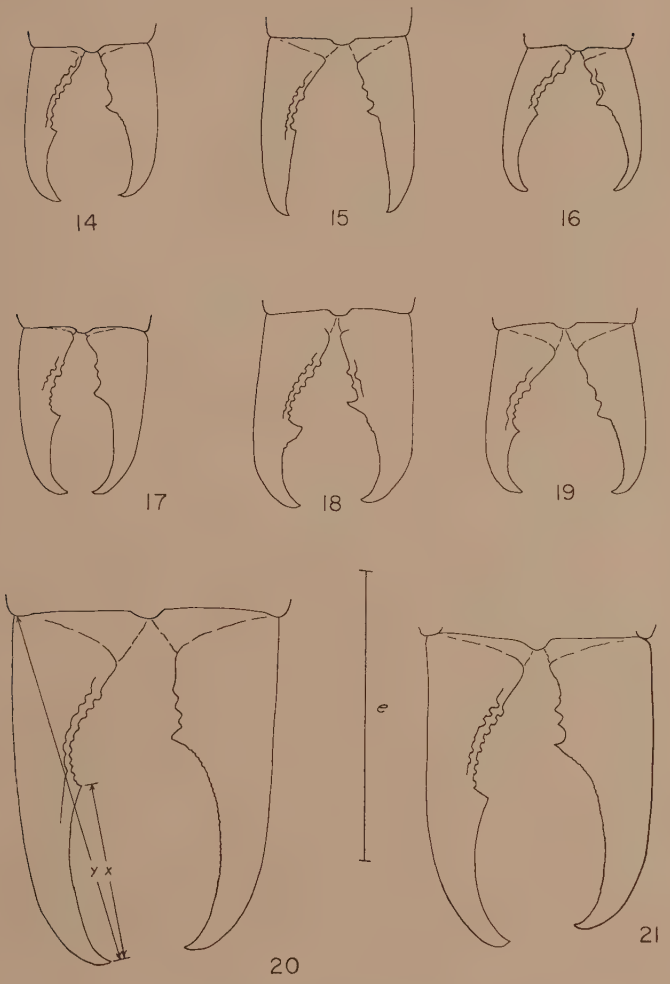
Holotype male, NEAR NASHVILLE, EL DORADO COUNTY, CALIFORNIA, March 5, 1958 (L. M. Smith and R. O. Schuster), in rocky soil, deposited in the California Academy of Sciences.

HOLJAPYX DIVERSIUNGUIS Silvestri

Female.—Similar to *H. calaverasae* L. Smith except: first lamina of lacinia with 10 teeth, maxillary palpus with 17 setae, labial palpus W:L=0.34, abdominal tergite I 2+2 M and 10+10 m, postero-lateral angles of tergite VII obtuse, not lobed, tergite VIII 4+4 M and about 10+10 m, tergite X 2+1+2 M and 11+11 m, carinae sclerotized, setae in rectum 56 not plumose, lateral subcoxal organs with two rows of glandular setae about 55+55, and one row sensory setae 35+35, sense setae clusters laterad of genital pore 8+8, Sr=0.26, forceps left arm R=0.500, predental tubercles 8/7, tooth fused with postdental margin, postdental margin smooth, curved, right arm postdental margin crenulate with 14 crenulations visible.

Male.—Similar to the female above except: male sac in III with eight plumose setae, male sac in IV with six plumose setae, Sr=0.28 median subcoxal organs with three rows of glandular setae, setae in rectum 52, not plumose, forceps left arm R=0.541, predental tubercles 7/9, right arm predental tubercles two or three, postdental margin crenulate with 17 crenulations visible.

Material examined: One male, Berkeley, California, March 24, 1938 (A. E. Michelbacher), determined by Dr. F. Silvestri, one male Mill Valley, Marin County, California, May 5, 1950 (Hugh B. Leech), in damp soil, and one female Mill Valley, May 9, 1955, collected by Mr. Leech in soil.



Explanation of Figures

Figs. 14–21, dorsal view of forceps (e=1.00 mm.): 14. *H. hyadis* ♀, 15. *H. imbutus* ♂, 16. *H. madidus* ♂, 17. *H. conspersus* ♂, 18. *H. schusteri* ♀, 19. *H. calaverasae* ♂, 20. *H. diversiunguis* Silv. ♂, 21. *H. conspersus* ♀. R=x/y as shown in fig. 20.

KEY TO THE SPECIES OF HOLJAPYX SILVESTRI

1. Abdominal tergite X with 2+2+2 M 2
   Abdominal tergite X with 2+1+2 M 6
2. Abdominal tergite I with 3+3 M 3
   Abdominal tergite I with 2+2 M 4
3. Tooth on left arm of forceps fused with postdental margin, R=0.438 ..... *imbutus* L. Smith
   Tooth on left arm of forceps not fused with postdental margin, R=0.371 ..... *calaverasae* L. Smith
4. Predental tubercles on right arm of forceps 1/1, R=0.532 ..... *madidus* L. Smith
   Predental tubercles on right arm monoseriate, R less than 0.500 5
5. Lateral subcoxal organs with one row of glandular setae, 22+22 ..... *irroratus* L. Smith
   Lateral subcoxal organs with two or three rows of glandular setae, 60 to 100 + 60 to 100 ..... *humidus* L. Smith
6. Predental tubercles of right arm of forceps biseriate, 1/2 ..... *schusteri* L. Smith
   Predental tubercles of right arm of forceps uniseriate 7
7. Postero-lateral angles of seventh tergite distinctly lobed ..... *conspersus* L. Smith
   Postero-lateral angles of seventh tergite acute or obtuse, but not lobed 8
8. Postero-lateral angles of seventh tergite obtuse, rounded, in female R=0.463, lateral subcoxal organs with one irregular row glandular setae 25+25 ..... *hyadis* L. Smith
   Postero-lateral angles of seventh tergite, acute, slightly projecting, in female lateral subcoxal organs with two rows of glandular setae 50 to 65+50 to 65 9
9. Left arm of forceps with tooth distinct, female, R=0.463 ..... *insiccatus* L. Smith
   Tooth fused with postdental margin, female, R=0.500 ..... *diversiunguis* (Silvestri)

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A NEW BEMBICINE WASP RELATED TO STICTIELLA TENUICORNIS (FOX), WITH CERTAIN PHYLOGENETIC CONSIDERATIONS

(Hymenoptera: Sphecidae)

James E. Gillaspy
Texas Lutheran College, Seguin

Most of the specimens in museum collections under the name *Stictiella tenuicornis* (Fox) have been found to represent a new species which is here described in connection with publication of biological data elsewhere on the genus *Stictiella*.

Stictiella clypeata Gillaspy, new species

Stictiella tenuicornis, Parker, 1917:47 (part); 1929 (part).

Female.—Length 14–19 mm. *Color* black except lemon-yellow maculation as follows: posterior orbits exceeding inner angles of compound eyes but not meeting at middle of vertex; upright V above frontal pit with upwardly widening, outwardly rounded arms receiving anterior ocellus, sometimes extending somewhat ventrad along midline toward socketal maculation; maculate enclosures of sockets except above in some cases, sometimes attenuated above along midline; broad anterior orbits narrowing unevenly to eye margins above at vertex; clypeus, labrum and scape entirely; flagellar segments ventrally except apical segments brownish; pronotum except median area posterior to streptaular suture and smaller lateral spots; mesonotum laterally on scutum and in anteriorly arcuately emarginate band across scutellum (latter margined with black posteriorly) outlining black shield containing tri-partite or complete U formed of lateral clavate marks and often medially notched posterior bar; tegulae; postcutellum except narrow anterior crescent; propodeal triangle except basal crescent; posterior face, postero-lateral angles and sides of propodeum except extra-triangle wedges broadest at spiracles, forming a V; metepisterna, hypoepimeral areas and mesepisterna except narrowly along sutures and pre-mesocoxal spot on mesepisterna; coxae and trochanters except base of some; femora except narrowly above (rarely entirely yellow); tibiae except narrowly below and tarsal segments except distitarsi often dusky above; first tergite except anterior face and squarish-lobate dorso-median posterior extension from it, which may reach the transverse gradular swell and there exhibit tri-radiate tendency, indicating (in combination with apical black) paired elliptic or ovate maculae which are fused mesally and indistinct in this species; tergites 2–6 with elements of this pattern usually discernible, but anterior dorso-median lobe transversely barlike before gradulus, often basally detached, also medially divided or tending to be so on tergites 3–6, never so on tergite 2, and tergite 6 without apical black; sternite 1 except narrowly at base; sternites 2–6 except basal arc, progressively more strongly developed toward rear, trilobate on sternite 6. *Vestiture* of clypeus and anterior orbits consisting of very dense, flattened, silvery-appressed hairs, completely concealing the integumental surface. *Head* wider than

thorax at posterior pronotal lobes (1.08:1.00); vertex and temples weakly developed behind large compound eyes which bulge laterally beyond them; vertex moderately depressed on either side of median elevation which attains but scarcely exceeds upper level of compound eyes; lateral ocelli separated from compound eyes by less than their own distance apart (1.0:1.2), forming approximately a 65° angle with anterior ocellus; latter a glabrous, flattened, brownish, mostly light-pervious (except intrusive black opacity from below) surface, defined above by a distinct, horseshoe-shaped sutural arch, glabrous surface extending beyond open end of arch below without evident sutural delimitation from frontal integument (confirmable by slide mounts), anterior ocellus including sutural arch and maximum extent of glabrous area below one-third longer than broad (1.6:1.0), enclosed in mound which appears U-shaped but is weakly closed above, the crest describing an oval with length twice the width; frontal line weakly impressed to frontal pit, weakly elevated below; intersocketal carina arising at middle level of antennal sockets, distinct to apex of clypeus. *Clypeus* width more than half of head width (1.0:2.3), wider than distance between compound eyes at vertex (1.00:0.90), compound eyes therefore appearing to diverge below, with least interocular distance (between antennal sockets and frontal pit) more than one-third of head width (1.0:2.6); surface of clypeus not strongly arched or so protuberant as to exceed plane of intersocketal carina when viewed laterally, distal margin distinctly receding; basal third of clypeus with a planate area on either side, separated from remainder of clypeus by a distinct angle; epistomal suture distant from lower level of antennal sockets by one-half of intersocketal distance, almost straight or slightly elevated between subantennal angles, which are weak, sloping downward slightly to tentorial angles, base of clypeus broadly subtruncate between tentorial angles, lateral sections of epistomal suture curving outward to compound eyes, recurving to lateral angles. *Mouthparts* with labrum longer than basal width (1.2:1.0); maxillae apicad of palpal base in length equal to about one-half of head width (1.00:1.96); maxillary palpi with six segments, labial palpi with four. *Antennae* with scape moderately stout, length about three times greatest width. *Thorax* with punctation of mesoscutum and scutellum uniform; propodeal triangle formed by inwardly bowed, almost rectilinear sutures, converging on posterior face of propodeum at about a 60° angle. *Legs* moderately slender: distitarsi without strong erect bristles ventrally and with large, bulbous pulvilli extending one-third or one-half length of claws; claws all similar, uniform in curvature, outer claw of each pair very little longer. *Wings* beyond humeral plate two and one-half times thorax width, measured at posterior lobes (2.53:1.00); second cubital cell subrectangular, wider than high. *Abdomen* with tergites 2–3 having smallest lateral punctures, exclusive of those in unpigmented marginal area, in same general size and density range as those of subsutural area of first tergite, but less extensive in area on tergite 3; tergite 4 with some lateral punctures almost equivalent in size and density to lateral punctures of preceding tergites, but tergite 5 with punctures entirely larger or more sparse.

Male.—Length 14–19 mm. General appearance and pattern of markings quite similar to female except maculation slightly less extensive. Labrum, clypeus and frons devoid of appressed-silvery pubescence. Clypeus and labrum narrower than in female, basal planate area of clypeus less pronounced. *Antennae* with second flagellar segment not thickened as compared to segments distad of it: antepenultimate segment about one-third longer than its width (1.6:1.0); flagellar segments apicad of second sharply, longitudinally carinate, without evident specialized sensory areas or pits; flagellar segments 3–10 weakly excised distally on side inward to curvature of antennae; penultimate segment without inner apical process. *Legs* moderately slender; distitarsi moderately slender, widening apically, length about three times greatest width, all rather similar in form and size; anterior femora moderately slender, not dorso-ventrally thin; anterior tarsal segments 2–4 not distinctly lobed or flattened; middle femora weakly fusiform, smooth, not notched. carinate, or serrate, and without toothlike projection ventrally at apex; middle tibiae moderately slender, equal in length to middle femora; calcar of middle tibiae moderately slender, apically curved and blunt, thumblike, brownish; middle basitarsi straight, apparently terete, ventral surface beset with several (about five) evenly spaced bristles, without bunched bristles at base and without apical process; second and third tarsal segments not produced apically; posterior basitarsi slender, sub-cylindrical. *Abdomen* with seventh tergite narrowed at apex, indistinctly bilobed, dorsal preapical surface coarsely, sparsely punctate, not polished; lateral margins above spiracular lobes inflected, in part broadly groovelike, receiving dorsal margin of spiracular lobes, grooved surface bare but adjacent dorsal surface with a few long hairs and spines; spiracular lobes moderately narrow, separated across venter by twice width of either, thin but entirely sclerotized, at apex narrowing to a dorsal point; surface of spiracular lobes with only few setiferous punctures, these distad of spiracle, which is placed well before apex. *Sternites* 2–5 flat, unmodified; sixth sternite flat, apical margin weakly convex; eighth sternite with three terminal processes, median one equalling half of sternite length, lateral processes flattened, slender, discal process represented by a weak, obtusely pointed carina arising between lateral processes. *Genitalia* with parameres very slender, slightly membranous ventrally at base, ventral surface mostly rather well sclerotized and with sparse, rather long hairs; volsellae with cuspis slender, long, slightly exceeding digitus in length; digitus and aedeagus with slender, elongate heads.

This species resembles *S. tenuicornis* (Fox) in general appearance but is less extensively maculated than that species, specimens of medium maculation having a variegated, severely angulated pattern. Punctation generally, especially on abdomen, finer and more uniform than in *S. tenuicornis*. The most broadly maculated specimens are those from Imperial Co., California. The specimens from Mexcala, Guerrero, Mexico have considerable extension

of black, with total markings perhaps about equally black and maculate in the female, and extensive black in the basal planate areas of the clypeus, on the mesonotum, tarsal segments dorsally, and first sternite at base. In addition the parameres of the genitalia are somewhat more slender than usual in these specimens from Guerrero.

Holotype male from 33 MILES EAST OF DEMING, DONA ANA COUNTY, NEW MEXICO, 4300 ft., August 2, 1946, and allotype female from Alpine, Brewster Co., Texas, July 1, 1942, both collected by H. A. Scullen, both deposited in the collections of the California Academy of Sciences, San Francisco.

Paratypic material as follows.—ARIZONA: Cochise Co., Ash Canyon, Hauchuca Mts., ♂ ♀, VIII.31.51 (C. D. MacNeill, JEG); Benson, 2♂, VIII.8.40 (E. S. Ross, CAS); Chiricahua Mts., ♀, IX.20.49 (D. K. Duncan, CU); Chiricahua Nat. Mon., ♂, VIII.23.51 (Lloyd Martin, LACM); Douglas, ♀ (W. W. Jones, CIS); 30 mi. N. Douglas, ♂, VII.17.42, 45 mi. N. Douglas, 4950 ft., ♂, VII.31.46 (H. A. Scullen, OSC); Pearce, 25 mi. E., 2♂, VII.29.54, fls. *Baccharis glutinosa* (Butler-Werner, UA); Pearce, 5 mi. S., ♂, VII.28.55, on *Acacia angustissima* (G. Butler and F. Werner, UA). Graham Co., Coolidge Dam, 16 mi. E., 2500 ft., ♀, VIII.7.46 (H. A. Scullen, OSC). Mohave-Yuma Cos., Bill Williams Fork, ♀, VIII. (F. H. Snow, UK). Pima Co., Tucson, ♂, VII. (J. Bequaert, MCZ), 2♂, VII.12.24 (A. A. Nichol, UACAS), ♀, VII.15.41 (R. H. Crandall, UA), ♂, VIII.16.27 (P. A. Readio, UK), ♀, VIII.17.46 (H. A. Scullen, OSC), ♂ ♀, VIII.28.51 (C. D. MacNeill, JEG); ♀, VIII.29.– (F. M. Carpenter, MCZ), ♀, X.8.23 (C. D. Duncan, SJSC). Tucson, 15 mi. E., 6♂, 2♀, VIII.30.51 (C. D. MacNeill, JEG). Santa Cruz Co., Madera Cyn., Santa Rita Mtns., ♀, IX.11.51 (C. D. MacNeill, JEG). Yavapai Co., Congress Jct., 1♂, 3♀, VII. (F. H. Snow, UK. CALIFORNIA: Imperial Co., Experimental Farm, 2♂, V.–11, 14♂, 3♀, VI.–12, ♂ VI.6.12, on *Baccharis glutinosa*, 6♂, VI.–11, ♀, VI.–12 with prey *Tubifera latifrons* (Loew) (J. C. Bridwell, USNM). Riverside Co., Ripley, ♂, VIII.19.46 (P. D. Hurd, CIS); Shavers Well, ♂, IV.–.34 (G. E. Bohart, GEB). KANSAS: Kearny Co., ♀, VIII.20.52, swept *Solidago* (H. E. Evans, HEE). NEW MEXICO: Dona Ana Co., Las Cruces, 30 mi. W., 2♂, VII.23.54 (H. E. Cott, UCD). Eddy Co., Carlsbad, 2♂, VIII.17.51 (H. E. Evans, HEE); Loving, ♂, VIII.16.50 (J. W. MacSwain, CIS); Malaga, ♂, VII.11.36 (M. B. Jackson, UK). Grant Co., Lordsburg, 19 mi. E., 4600 ft., 19♂, VIII.1.46, 15 mi. E. ,4500 ft., 2♂, VIII.1.46 (H. A. Scullen, OSC); Separ, 3 mi. S., ♀, VIII.11.29, on *Salsola pestifer* (V. E. Romney, USNM). Hidalgo Co., Rodeo, 17 mi. N. of, 4200 ft., VIII.1.46 (H. A. Scullen, OSC). Luna Co., Deming, 20 mi. S., 4200 ft., 7♂, 2♀, VIII.2.46 (H. A. Scullen, OSC); 10 mi. E., VII.12.17 (R. C. Shannon, CU). TEXAS: Bexar Co., 2♂, V.25.31 (H. B. Parks, TAMC). Brewster Co., Alpine, ♀, VII.1.42, 2♂, VII.8.42 (H. A. Scullen, OSC); Chisos Mts., ♀, VI.10–12.08 (Mitchell

and Cushman, USNM); Dugout Wells, 2♂, VIII.25.54 (R. M. Bohart, UCD); Glenn Spring, 3♂, 9♀, VI.16–VII.3.28 (F. M. Gaige, UM); Santa Elena Cyn., 2145 ft., 2♀, VIII.25.54 (R. M. Bohart, UCD). El Paso Co., Sierra Blanca, ♂, VII.8.17 (CU); El Paso, ♀, VIII.19.54 (R. M. Bohart, UCD). Hudspeth Co., Cornudas, ♂, VIII.16.51 (H. E. Evans, HEE); Finlay, ♂, VII.2.30 (J. O. Martin, CAS); Salt Flat, ♂, ♀, VIII.16.51, on *Baccharis* (H. E. Evans, HEE). Jeff Davis Co., Ft. Davis, 10 mi. S., 1♂, 2♀, VI.30.42 (H. A. Scullen, OSC); White Rose Canyon, ♂, VI.18.47 (A. T. McClay, UCD). Midland Co., Midland, ♀, VI.6.13 (F. C. Bishop, USNM). Pecos Co., Pecos River, Sheffield, ♂, VII.26.21 (C. D. Duncan, SJSC). Presidio Co., Marfa, 4000 ft., ♂, VII.15.46, ♂, VII.30.36 (H. E. Evans, HEE); Presidio, ♀, VIII.14.29 (E. R. Tinkham, ERT). Webb Co., Laredo (inside automobile), ♀, VII.22.42 (USNM). MEXICO: Guerrero, Mexcala, 2♂, 2♀, VI.29.51 (H. E. Evans, HEE). Chihuahua, Chihuahua, 1♂, 2♀, VIII.12.51, on *Baccharis*, ♀, VIII.12.51 (H. E. Evans, HEE); Jimenez, 18 mi. W., 13♂, 2♀, VIII.10.51, on *Baccharis* (H. E. Evans, HEE); Villa Ahumada, 3♂, 1♀, VIII.14.51 (H. E. Evans, HEE). Coahuila, Paila, 3900 ft., ♀, VIII.21.47 (D. Rockefeller Exp., Cazier, AMNH).

Recorded Distribution.—Arizona: (Parker, 1917). New Mexico: Eddy Co., "Delaware Creek just north of state line" (Painter, 1932, 1936). Texas: Brewster Co., Chisolm (sic) Mts. (Parker, 1929); Glenn Springs (Steyskal, 1939); Reeves Co., 9 mi. S. of Texas-New Mexico state line on Texas Highway No. 17 (Painter, 1932, 1936); Webb Co., Laredo (Parker, 1929).

STICTIELLA TENUICORNIS (Fox)

Monedula tenuicornis Fox, 1895:368 (♀, not ♂) (Type: ♀, San Bernardino County California; Coquillett, USNM).

Stictiella tenuicornis, Parker, 1917:47 (part); 1929:43 (part).

Female.—Length 17–20 mm. *Color* black except light-yellow maculation which covers roughly more than three-fourths of total body area (compared with about three-fourths for most *S. clypeata* Gillaspy). Pattern essentially that of *S. clypeata* except some expansion of maculate loci and reduction of black loci; mesonotal U always tri-partite; anterior dorso-median lobe of first tergite rounded, tongue-like, never tri-radiate; elliptic-ovate maculae of first tergite very faintly indicated by apical black; anterior dorso-median lobe of tergite 2 represented by a pair of spots which are also represented on tergites 3–6.

Structural differences from *S. clypeata*: Least interocular measurement slightly higher, between anterior ocellus and frontal pit, ratio to head width nearer one-third (1.0:2.8); punctation of mesoscutum and scutellum not uniform, having interspersed larger punctures; abdominal tergite 2 with smallest lateral punctures, exclusive of unpigmented margin, in same size and density range as those of subsutural areas of first tergite; tergite 3 with smallest punctures perceptibly but not greatly larger; tergite 4 with distinctly coarser, sparser punctures.

Male.—Length 17–19 mm. Middle femora with large notch occupying most of apical third, the notch bearing an acute, inwardly directed process at base and apex; middle basitarsi straight, apparently terete, ventral surface with single longitudinal row of bristles and with thornlike process at apex, second and third tarsal segments of this leg similarly produced; seventh tergite with sides somewhat roundly tapering to narrow, distinctly notched apex; spiracular lobes separated across venter by somewhat more than width of either; genitalia with minor differences.

Recorded Distribution.—California: San Bernardino Co. (Fox, 1895).

Neallotype (present disignation): Male from CONSTANTIA, LASSEN CO., CALIFORNIA, August 2, 1951, on *Eriogonum* (J. E. Gillaspy, Collector), deposited in the collections of the California Academy of Sciences.

Material examined.—CALIFORNIA: Inyo Co., Owen's Valley, ♀, VIII.7.36 (G. E. and R. M. Bohart). Los Angeles Co., Palmdale, ♂, VIII.1.35 (E. I. Beamer). Riverside Co., Santa Rosa Mt., ♂, VI.15.48 (D. J. and J. N. Knull, OSU); Whitewater, 1♂, 1♀, VII.16.50 (P. D. Hurd, CIS). San Bernardino Co., Cushenbury Springs, 2♀, IX.1.36, on *Lepidospartum squamatum* (Timberlake, UCR, JEG); Yucca Valley, ♂, VIII.20.36, on *Croton californicus* (Timberlake, UCR); Victorville, 1♂, 1♀, VIII.14–15.27 (CU). NEVADA: Washoe Co., Reno, ♀, VII.16.40, ♀, IX.15.40 (Ira La Rivers, JEG, UN). MEXICO: Baja California, Sierra Juarez, ♀, X.10.53 (F. X. Williams, CAS).

In Parker's key the males of this species run to *S. divergens* Parker, a form which probably should be regarded as a subspecies of *S. femorata* (Fox). Differences of *S. tenuicornis* (Fox) from *S. divergens* are in the character of the middle femora, which in *S. divergens* are longitudinally emarginate through most of their length and in addition have a small apical notch; in the size, which does not exceed 13 mm. in *S. divergens*, and in the anterior ocellus, which in *S. divergens* is distinctly broader than long. The apical notch of the femora and strongly developed discal process of the eighth sternite distinguish *S. tenuicornis* males from those of *S. clypeata* Gillaspy. In the female the generally coarser, more widely spaced and less uniform punctation, specifically the coarser lateral punctation of the third and following tergites as compared with that of the first and second tergites, provides the principal character distinguishing *S. tenuicornis* from *S. clypeata*. The pair of pregradular black spots of the second abdominal tergite of *S. tenuicornis*, as compared

with the unified bar of *S. clypeata*, will also separate the females of all specimens I have seen.

These descriptions have been prepared with reference to all species considered by Parker to fall within his genus *Stictiella*, as well as certain undescribed species which differ in some respects from his generic diagnosis. Definable species groups, possibly worthy of designation as genera and/or subgenera, seem to be these: *S. pulla* (Handl.) group, [*exigua* (Fox), *argentata* (Fox), *scitula* (Fox)]; undescribed form with palpi reduced, pulvilli distinct; *S. pictifrons* (Smith) group, [*clypeata* Gillaspy, *tenuicornis* (Fox), *bituberculata* Parker, *terlinguae* C. L. Fox, *bifurcata* C. L. Fox, *megacera* Parker]; *S. emarinata* (Cress.) group, [*speciosa* (Cress.), *formosa* (Cress.)]; *S. pulchella* (Cress.) group, [*plana* (Fox), *serrata* (Handl.), *melanosterna* Parker, *callista* Parker, *tuberculata* (Fox)]; and the *S. femorata* (Fox) group, [*divergens* Parker].

A few characters believed to display the phylogeny of these wasps are: form and degree of opacity of the anterior ocellus; positional and form interrelationships of clypeus, compound eyes and antennal sockets; degree of reduction of pulvilli and palpi; comparative lengths of genital cuspis and digitus; modification of the parameres from flattened, bladelike form; length of maxillae and labrum; and degree to which the vertex is depressed. The *emarginata* and *pictifrons* groups appear to represent many primitive features of the Bembicini.

K. V. Krombein of the United States National Museum kindly compared specimens of *tenuicornis* and *clypeata* with the holotype of *tenuicornis*, and H. E. Evans brought to my attention the papers by Painter.

Institutional and individual collections are abbreviated as follows: AMNH, American Museum of Natural History, New York; CAS, California Academy of Sciences, San Francisco; CIS California Insect Survey, University of California, Berkeley; CU, Cornell University, Ithaca, New York; ERT, E. R. Tinkham, Indio, California; GEB, G. E. Bohart, Ogden, Utah; HEE, H. E. Evans, Ithaca, New York; JEG, J. E. Gillaspy, Montclair, California; LACM, Los Angeles County Museum, Los Angeles, California; MCZ, Museum of Comparative Zoology, Cambridge, Massachusetts; OSC, Oregon State College, Corvallis; SJSC, San Jose State College, San Jose, California; TAMC, Texas

Agricultural and Mechanical College, College Station, Texas; UA, University of Arizona, Tucson; UCD, University of California at Davis; UCR, University of California at Riverside; UK, University of Kansas, Lawrence; UM, University of Michigan, Ann Arbor; UN, University of Nevada, Reno; and USNM, United States National Museum, Washington, D.C.

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A RECORD OF PYRAMIDOBELA ANGELARUM KEIFER FROM SANTA CRUZ, CALIFORNIA

(Lepidoptera, Ethmiidae)

Pritchard and Powell[1] have recorded this species from San Mateo County, Alameda County and Contra Costa County, California. In the collection of the author are two specimens reared from *Buddleia* sp. from within the city of Santa Cruz, Santa Cruz County. The emergence date is September, 1947. The larvae were taken from rolled up leaves at the tips of the food plant, and the infestation was heavy, most of the tips being affected, indicating that the moth must have been well established. This note is presented as another link in the distribution of this moth, which seems to follow plantings of its introduced host plant.—J. W. Tilden, *San Jose State College, San Jose, California.*

[1] Pritchard, A. E., and J. A. Powell, 1959. Pan-Pac. Ent., 35(2) :82.

BIOLOGICAL OBSERVATIONS ON PSAMMAECIUS ADORNATUS (BRADLEY)

(Hymenoptera: Sphecidae)

Jerry A. Powell and John A. Chemsak
University of California, Berkeley

The solitary wasps of the gorytine genus *Psammaecius* are ground nesting species which utilize membracids and cicadellids as prey. Most of the known biological information on the North American species is based on two eastern species, *P. costalis* (Cresson) (Reinhard 1925a, b) and *P. tricolor* (Cresson) (Evans, Yin, and Yoshimoto 1954). Evans *et al.* have reviewed the literature on the biological knowledge of the genus in their discussion of *P. tricolor*.

An active nesting site of *Psammaecius adornatus* (Bradley) was located May 17, 1958 on Mt. Diablo, Contra Costa County, California. Intermittant observations were made during the afternoon of that day, and the same site was revisited on May 21 during the morning hours. The species was found nesting at Arroyo Seco, Monterey County, California at approximately the same time by E. G. Linsley, J. W. MacSwain and R. M. Bohart, and they contributed additional observations.

We are indebted to several specialists for the determination of the species cited below: Dr. R. M. Bohart, University of California, Davis (the *Psammaecius*, Nyssonini and Chrysididae), Dr. F. R. Cole, University of California, Berkeley (Bombyliidae), W. E. Ferguson, University of California, Berkeley ,Mutillidae), Professor H. J. Reinhard, Texas A. and M. (Sarcophagidae) and Miss Louise Russell, U.S. National Museum (Membracidae). Acknowledgment is also made to Marius S. Wasbauer, University of California, Berkeley, for reading the manuscript and offering helpful suggestions.

The Mt. Diablo site was located along the sandy border of a level, gravel-covered parking area at an approximate elevation of 1500 feet on the southwest slope of the mountain. The unshaded area occupied by the site extended in a five foot wide strip for about 65 feet along the edge of the roadway. There were estimated to be 60 to 80 active female wasps within this area during the period of observation, however nearly all of the observations were made in a zone of about five by ten feet where over half of the wasps were concentrated. Ground cover here was sparse,

consisting of scattered clumps of *Erodium cicutarius* l'Her. and a small amount of grass, oak leaves and other debris. The weather during the two days of observation was essentially clear and warm, although on the latter (May 21) some high cloudiness reduced activity slightly at times.

Accumulated observations over the two days indicated a general behavior pattern for the females as follows. The night is apparently spent removed from the site. Morning observations began at 8:10 A.M. (Pacific Daylight Time) while the sun was still partially obscured by morning fog and activity at the site had not yet commenced. Females were soon observed, apparently flying in from other areas. The first was observed at 8:45, and by 9:15 individuals were fairly numerous about the observation area. At first the females alighted on open areas in the sunlight, remaining still or only moving the body up and down. Individuals went through these motions for 10 to 20 seconds before flying a short distance away. It is assumed that this was a warming up process. Following this, the females crawled about and scratched in the loose surface sand for some minutes before finally selecting a suitable burrow site. The search for burrow sites had begun by 9:15 (when it was already quite warm) and many successful burrows were under way by 9:30. Digging operations continued for about two hours before provisioning began, which by noon was well under way. The prey consisted entirely of membracid nymphs, primarily a species of some genus of Ceresini, possibly *Stictocephala*, although two females were taken on May 17 with nymphs of a larger prey species, possibly some genus of Telamonini. The transport of prey to the burrows lasted through the afternoon until temperatures began to drop. A few wasps were still evident around the site after 5:30 P.M., but none with prey. It seems unlikely that the females spend the night in their burrows since we were unable to recover any during evening excavations in the nesting area. We were unable to determine the location of the resting sites of the females.

Males were collected about the site during the early afternoon hours at the height of provisioning activities but not in the morning while the females were digging. One male was swept from a nearby oak, the host of the membracids, late in the afternoon.

Apparently a new burrow is constructed by the female each morning. The precise location of burrows varied; most were in open areas, often in slight depressions, some were adjacent to pebbles or other debris, while others were under oak leaves or under clumps of *Erodium*. The digging process seemed to be rather consistent, with only slight individual variations. The digging was commenced with the forelegs, the wasp always being directed head first. As the burrow deepened, sand was kicked back almost continuously with the hind legs. After five to ten minutes the wasp had lengthened the burrow so as to disappear completely into it. As the burrow progressed, the length of time spent in the burrow increased with the wasp periodically reappearing. Upon each reappearance the wasp would back-up four or five centimeters from the entrance, pause a few seconds, then gradually progress forward to the entrance kicking the loose sand behind. This procedure resulted in a shallow trackway of loose sand curving away from the burrow. During the initial stages of the digging the wasp could be seen reappearing often, however after half an hour or more of the operation, from three to over five minutes were usually spent below the surface. In the final stages the wasp reappeared head first forcing the sand out ahead of her. After this type of emergence the female would repeat the previously described procedure of removing the loose sand. Construction of the burrow took two to two and one-half hours in the few cases in which the entire process was observed. This appeared to be the approximate time required for most of the burrows since most of the individuals in the colony began provisioning at about the same time. The earliest time of completion of any burrow under surveillance was 11:20 A.M.

The first indication of termination of the digging operation was the behavior of the female in covering the entrance. Sand was kicked backward over the aperture from all sides, periods of kicking being alternated with short hovering flights one to two cm. above the burrow. After two or three minutes the burrow was reentered for a few seconds. Upon emergence the entrance was again covered and the wasp resumed the short hovering flight, this time six to eight cm. high. In one instance this reentry and covering process was twice repeated. Following the short flights, the female made several longer hovering arcs

a meter or more above the burrow site before flying away. It is assumed that this behavior pattern, involving repeated coverings of the burrow and hovering flights, is one of area recognition by the female wasp.

Although the first female was seen to return with prey at 10:57 A.M., provisioning of most burrows did not begin until nearly an hour later. By noon the burdened females were appearing almost continuously.

Each of the wasps carried the prey in a similar manner, grasping it with the hind legs. The treehopper nymph was held under the wasp's abdomen in a venter-up position with its head oriented forward. The wasps were usually first seen flying into the nesting area with prey two or three meters above the ground. Upon attaining a position approximately above the burrow at this height, the female initiated a very characteristic descent. Assuming a hovering action, the wasp rapidly dropped to within a meter of the sand while orienting herself into a position directly over the burrow. The final part of the descent was made with gradually diminishing speed, requiring eight or ten seconds, until the wasp briefly hovered just above the burrow before alighting. After a few seconds pause the female quickly opened the burrow entrance with her fore legs and entered, without changing the position of the prey. Usually about 20 seconds (8 to 30 seconds) were spent in the deposition of the prey. Usually the burrow entrance was covered upon each departure. Closure after the first time or two was affected by merely kicking sand backward over the entrance from one direction before flying directly off. There was considerable variation expressed by every individual observed in the time required for provisioning flights and there was no apparent correlation in differences between the length of time required by individuals. One made 14 observed trips ranging from two to 20 minutes with an average of nine minutes, another made nine trips ranging from two to 17 minutes and averaged ten minutes. A third ranged from three to 14 minutes in 11 trips averaging about seven minutes. It is not definitely known at what distance the source of prey was located, but *Stictocephala* nymphs were swept in small numbers from nearby (20-30 feet distant) *Quercus agrifolia*.

Observations were interrupted in the early afternoon on May 17 for 40 minutes and concluded in the evening at 4:15 P.M.

before the provisioning activities had ceased entirely, so that the number of trips per day is not definitely known. Judging from the frequency of trips during the observation periods in the two days, it is estimated that about 20 to 25 nymphs were carried in each day. Since it was later determined that each cell was provided with 12 or 13 membracids, we assume that the normal pattern of activity involves the provisioning of two cells each day. However, in our excavation we were unable to definitely correlate two cells with any particular burrow.

When our excavations were commenced at 5:30 P.M. there were still one or two wasps active about the site, but provisioning had apparently ceased. The filling of the tunnels had already been completed and was not observed. We found that it was impossible to trace the tunnels of marked burrows in these evening excavations. Evans *et al.* (1954) state that *P. tricolor* (Cr.) probably fills the burrow by scraping sand from the sides, and a similar behavior with *P. adornatus* seems probable and would account for the obliteration of the tunnel. Subsequent excavation of open burrows in the early afternoon of May 21 revealed the nature of the tunnels.

The soil in the area was found to consist of an upper layer of unconsolidated fine sand about seven or eight cm. in depth with an underlying layer of hard packed clay loam. Seven of the burrows were successfully exposed by tracing their courses with dry straws. These were found to show considerable variation in formation but not in depth. In general the tunnels were found to be about seven cm. in length (range 6.5 to 17 cm.) angling into the ground at about 30° to 40° with one bend, usually about halfway along the length but sometimes immediately after the entrance. The bend varied from 60° to 90° laterally from the original course either to the right or left with a steepening sometimes occurring after the bend. The tunnel terminated in an oval cell measuring about 6 mm. by 15 mm. with its long axis oriented with the tunnel direction. Nearly all of the cells were found just at the base of the loose sand, about 5 to 6 cm. below the surface.

In addition to the cells associated with the tunnels, numerous other cells were uncovered, presumably the result of earlier activity by the colony. Fully provisioned cells were found to contain 12 to 14 ceresine nymphs. However one cell contained

11 telamonine nymphs and two of the smaller Ceresini. Several of the wasp eggs were also covered. The whitish egg is elongate, smooth and slightly curved, tapering at both ends and measuring about 2.5 mm. in length and 0.5 mm. in width. The position of the egg was constant, lying longitudinally along the venter of the thorax of the treehopper just laterad of the coxae. One small larva and one fairly mature larva were found. These were presumed to be those of *P. adornatus* although numerous adults of three nyssonine parasites were active in the area.[1] In feeding, the larva removes the contents of the prey body, leaving the exoskeleton intact except for the abdominal sternites or the entire sternum.

A number of insects of parasitic groups were collected in the nesting site during the two days of observations, certain of which seem to have a definite relationship with *P. adornatus*.

Two species of *Epinysson* and one *Nysson* were seen in numbers about the nesting area. Since members of the group are said to be cleptoparasites of gorytine wasps (Evans *et al.*, 1954), these seem to be definitely associated with the species under study. The most abundant of these was *Epinysson moestus* (Cresson) both sexes of which were active during most of the day. Females of this species were taken at the nesting site before 9:00 A.M. while still very sluggish and behaving similarly to the early *Psammaecius* females. Activity of both sexes was quite pronounced before construction of the burrows by *P. adornatus* had been completed and continued throughout the afternoon. Individuals were frequently seen investigating or entering open burrows or other holes. One was seen to enter a burrow with the digging occupant inside. The parasite emerged about three seconds later, flew out a few inches, reentered the burrow, and then both came out after a few seconds. Another was observed to dig its way into a temporarily closed burrow and remain within for almost eight seconds. The wasp, a female, was collected upon its reappearance. Six females and three males of *Epinysson pumilis* (Cresson) were taken during the afternoon, and 12 females of *Nysson rusticus* Cresson were also collected while the provisioning of *Psammaecius* was in progress. A single male of the latter nyssonine was taken late in the afternoon.

[1] The larvae have been sent to H. E. Evans for further study.

Several additional species known to be parasites of Hymenoptera were observed but had no apparent definite association with *P. adornatus* other than their occurrence in the nesting area. The hymenopterous parasites included the following: Chrysididae; *Omalus cressoni* Aaron, one female and *Hedychridium* sp. three females, (both species collected in the afternoon). Mutillidae; *Dasymutilla californica* (Radoszkowski), two females (11:10 A.M., 4:30 P.M.) and *Sphaeropthalma* sp., one female (8:30 A.M.). Among the Diptera were: Bombyliidae; *Lepidanthrax inaurata* Coquillett, one male and female (afternoon), Sarcophagidae; *Senotainia* sp. nr. *vigilans* Allen, one female (afternoon), *Senotainia trilineata* van der Wulp, one female (late afternoon), *Metopia leucocephala* (Rossi) two females (late A.M.).

Additional observations by Linsley, MacSwain, and Bohart on *Psammaecius adornatus* (Brad.) at Arroyo Seco, Monterey County, California showed that the nesting activities were going on concurrently with the Mt. Diablo population. The provisioning behavior at the Arroyo Seco colony was reported to be almost identical with that described above. The prey here also consisted of an undetermined membracid nymph.

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A NEW SPECIES OF CHAETOSTOMA FROM CALIFORNIA

(Diptera: Tephritidae)

F. L. Blanc

California Department of Agriculture, Sacramento

The tephritid herein described has been confused for many years with *Chaetostoma rubida* (Coquillett) because of its close relationship to that species. D. W. Coquillett described *rubida* in 1899 and placed it in the genus *Epochra*. The type (U.S. National Museum No. 4397) is from Colorado.

Recent study of California *Chaetostoma* specimens in the

various private and institutional collections on the Pacific Coast reveals that these are all distinct from the type material of *rubida* (Coq.) and from other *Chaetostoma* specimens from Colorado and Montana.

Chaetostoma elizabethae Quisenberry, described from Northern Colorado, is a synonym of *C. rubida* (Coq.). (New synonymy.)

Chaetostoma californica Blanc, new species

Male.—Head: Front orange to straw-colored, surface with sparsely scattered short, fine setae; front wider at vertex than width of one eye. Three pairs of black lower fronto-orbitals; two pairs of black upper fronto-orbitals which curve almost directly caudad. Antenna approximately as long as face, with terminal segment straw-colored tinged with pink, thinly grayish pruinose; arista bare and black except for light brown base. Face pale golden yellow blending to deep orange and faintly pruinose with white; face in lateral view only weakly protruding. Oral edge of bucca with a row of about 10 coarse, black bristles with a few finer black setae at the posterior end of the row. *Thorax:* Mesonotum deep orange, faintly pinkish in posterior portion, thinly white pruinose, rather uniformly covered with closely set fine, short, brown setae. Dorsocentrals on a line with supraalars. Scutellum orange, faintly rose-pink in center at base; two pairs of long black scutellar bristles; a few minute dark-brown setae beginning just cephalad to anterior scutellars and extending almost to posterior scutellars. Mesopleuron glabrous, yellow-orange to ochreous, with a white-to-pale-yellow band extending longitudinally caudad from just beneath the humeral bristle, extending along the dorsopleural suture to the wing attachment. Mesosternum near median line and anterorventral surfaces of all three pairs of coxae clothed with numerous long, black bristles. Femora orange to ochreous, tinged with rose in the central portion of each segment; hind femora with three strong setae before the apex dorsally; tibiae yellow, becoming pale near apices; tarsi pale yellow dorsally and white ventrally. *Wing:* (fig. 1)Hyaline with five brown maculations as follows: first begins at junction of costa and humeral crossvein and extends posteriorly to bases of the second basal and anal cells; second originates at juncture of costa and auxillary veins and extends posteriorly, crossing parallel and bordering mesally on basal crossvein, ending at distal point of the anal cell; third extends posteriorly from a point on costa one-third the distance from apex of first longitudinal vein to apex of second longitudinal vein, continues along the length of anterior crossvein, ending about half way through third posterior cell; fourth begins at (or very slightly anterior to) juncture of fourth longitudinal vein and posterior crossvein, then follows the crossvein posteriorly, meeting caudal wing margin at (or slightly mesad to) terminus of fifth vein; fifth maculation begins at costa about two-thirds the distance from apex of first vein to that of second vein and extends posteriorly only as far as second vein, but extends distally along costal wing margin to apex of fourth vein, the band becoming narrow or extinct at apex of second vein. Stigma

non-transparent yellowish-white. Third longitudinal vein dorsally with 17 well-spaced black setae extending from base to slightly beyond anterior crossvein. Juncture of anterior crossvein with discal cell slightly less than two-thirds the distance from basal crossvein to posterior crossvein. *Abdomen:* Glabrous orange to ochreous tinged with rose; fifth abdominal tergite bearing a large, round reddish-brown to black maculation dorso-laterally; tergites evenly covered with short fine setae; distal tergites each with a row of longer black bristles on the caudal margin; genitalia with forceps abruptly bending posteriorly at about a 35° angle, claws of forceps attached so that their extremities almost reach apices of forceps, the latter bearing one or two long setae close together and just beneath the tips of the claws.

Female.—Same as male in chaetotaxy and color except lacking the large dorso-lateral maculation on the fifth abdominal segment.

EXPLANATION OF PLATE

Fig. 1. Wing of *Chaetostoma californica* Blanc.

Holotype male: LA MESA, SAN DIEGO COUNTY, CALIFORNIA, February 11, 1957 (G. L. Hill), deposited in the California Academy of Sciences. Allotype female: San Ysidro, San Diego County, California, June 6, 1957 (J. L. Johnson); deposited in the California Academy of Sciences.

Paratypes: 29 males and 36 females (all from California) as follows: *San Diego County:* 1♀, La Mesa, Jan. 8, 1959, J. Gaven; 1♀, La Mesa, Mar. 11, 1959, G. L. Hill; 1♂, San Ysidro (4 miles E.), Feb. 11, 1957, Edward Soukup; 1♀, San Ysidro, June 10, 1957, J. L. Johnson; 1♂, San Ysidro, Sept. 6, 1957, R. D. Hancock; 3♂♂ and 2♀♀, Alpine,

Jan. 27, 1959, D. Close; 5♀♀, Alpine, Mar. 2, 1959, D. Close; 2♂♂, Hipass, Dec. 20, 1958, D. Close; 1♂ and 6♀♀, Campo, Jan. 28, 1959, S. M. Klopfer; 1♂, Campo, Feb. 19, 1959, D. Close; 1♂, Pine Valley, Nov. 29, 1958, D. Close; 1♀, Tecate, Dec. 18, 1956, G. L. Hill; 3♀♀, La Posta, Feb. 28, 1959, D. Close; 1♀, El Cajon, Mar. 2, 1959, D. Close; 1♀, Guatay, Feb. 28, 1957, Wiest; 1♀, La Jolla, Mar. 11, 1957, S. M. Klopfer; 1♀, Fallbrook, Feb. 6, 1957, D. F. Palmer; 1♀, Dulzura, Aug. 9, 1959, D. Close; 1♀, Winter Gardens, Mar. 3, 1959, D. Close. *Los Angeles County:* 1♂, Long Beach, July 12, 1957, Paul Engler. *Santa Barbara County:* 1♀, Carpinteria, May 13, 1959, I. B. Treloar; 1♀, Summerland, Aug. 12, 1957, Guy Beevor; 1♂, Santa Barbara, Sept. 4, 1957, Guy Beevor and H. T. Osborn; 1♂, Goleta, Sept. 18, 1957, Guy Beevor; 1♂, Goleta, Sept. 19, 1957, Guy Beevor; 1♀, Goleta, Oct. 21, 1958, Marcus Cravens. *San Luis Obispo County:* 1♀, Atascadero, Nov. 12, 1958, J. Williams. *San Mateo County:* 1♂, Redwood City, Sept. 19, 1957, Max Leonard; 1♀, Redwood City, Aug. 1958, R. C. Lauder; 1♂, Portola, Oct. 22, 1958, San Mateo County Department of Agriculture. *Alameda County:* 1♂, Castro Valley, Sept. 20, 1957, Jerry Marston; 2♂♂ and 1♀, Fremont, Sept. 12, 1957, Ralph Freeman; 1♂, Centerville, Aug. 1953, R. P. Allen; 2♂♂ and 2♀♀, Centerville, Nov. 21, 1958, Johnson and Sibray; 1♂, Berkeley, Oct. 6, 1907, H. H. P. Severin; 1♂ and 2♀♀, "Hills back of Oakland," Oct. 6, 1951, W. C. Bentinck; 1♂, Livermore, Aug. 1958, T. R. Haig; 1♂, "Alameda County," Sept. 13, 1956, T. Enos. *Sonoma County:* 1♀, Petaluma, July 25, 1957, F. K. Jarvinen; 1♂, Glenn Ellen, July 15, 1957, M. G. Dornbush; 1♂, Santa Rosa, Sept. 15, 1956, T. B. Gallion.

Paratypes are deposited with U.S. National Museum; California Insect Survey (University of California, Berkeley); University of California (Davis, California); and the Bureau of Entomology, California Department of Agriculture, Sacramento, California.

Chaetostoma californica Blanc differs decidely from the closely related *rubida* (Coq.) in the nature of the brown wing maculations. In *rubida* the fourth and fifth bands definitely join at the costal margin of the wing. The fourth and fifth maculations of *californica* are widely separated, the fourth extending anteriorly barely past the juncture of the fourth longitudinal vein and the posterior crossvein.

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OCCURRENCE OF SPERMATOPHORES IN CERTAIN SPECIES OF CHILOCORUS

(Coleoptera: Coccinellidae)

T. W. Fisher

Citrus Experiment Station, University of California, Riverside

During the past ten years several species of diaspine-scale-feeding coccinellid beetles have been under propagation at the Citrus Experiment Station, Riverside, California, the host being mainly latania scale, *Hemiberlesia lataniae* (Signoret), on potato tubers. In the routine inspections for eggs and small larvae among the host scales, some peculiar, rather pyriform pellets were encountered in the cultures of *Chilocorus* spp.[1]

A culture of *Chilocorus cacti* (Linnaeus) was started in the fall of 1954 from a small colony taken from mesquite in southeastern Arizona. During a study of the larval characteristics of this species, numbers of the peculiar pellets were observed in the debris of the culture cage.

Explanation of Figure

Fig. 1. Left to right, fecal castings, eggs, and spermatophores of *Chilocorus discoideus* Crotch, an African species that produces a larger spermatophore than does *C. cacti*. Scale is in millimeters.

Observations on the origin of the pellets showed that (1) unmated females produced no viable eggs and no pellets; (2) a group of mated females produced viable eggs and fewer pellets

[1] The interest and assistance of M. E. Badgley, Senior Laboratory Technician, is gratefully acknowledged.

than there were females; (3) a group of unmated females placed and held with males eventually produced viable eggs and more pellets than there were females; (4) males alone produced no pellets. These observations were facilitated by the obvious sexual dimorphism in the adults of *C. cacti*. A correlation between mating and pellet formation was thus indicated and suggested the possibility of the pellets being spermatophores. A survey of the literature revealed no mention of spermatophores as occurring in the Coccinellidae. Cros (1924) and Khalifa (1949) reported spermatopores in the Coleoptera only in the families Cantharidae, Chrysomelidae, Curculionidae, Dytiscidae, Meloidae, and Scarabaeidae. The present study shows that the family Coccinellidae, as represented by eight species of *Chilocorus*, belongs in this list. Spermatophores were found in *Chilocorus cacti*, *C. discoideus* Crotch, *C. distigma* Klug, *C. fraternus* LeConte, *C kuwanae* Silvestri, *C. orbus* Casey, *C. stigma* Say, and a new species from Kenya.

Attempts to determine the source and function of the pellets were made along two lines: (1) the chemical and/or physical nature of the pellets, and (2) their functional role. *Chilocorus discoideus* only was used in this study (fig. 1).

Physical properties: The voided pellets are roughly pyriform, 0.8 × 1.5 mm. in size, pearl white or yellow to brown in color, and are hollow with a small orifice at the narrow end. The wide end is closed. Under 3600 Angstrom units of ultra-violet light the pellets fluoresce brightly both from their outer and inner surfaces.

Chemical properties: The Van Wisselingh test for chitin gave a negative response. When held in distilled water, glacial acetic acid, and 10% KOH, the pellets become soft and rather amorphic. These solvents also become fluorescent. Ethyl alcohol (95%) seemingly does not change their appearance nor does it become fluorescent. A preliminary biochemical analysis showed indications of fat, protein, and carbohydrates.

Functional role: The relationship of the pellets to mating has already been mentioned. Observation of pairs of *Chilocorus discoideus* revealed that they remained in copula for 40 to 105 minutes. The females voided the pellets as hollow bodies 18 to 24 hours later. From a group of both sexes which contained 30 females, the number of cast-off pellets indicated that each female mated an average of 32 times during a four-month period. Gross

dissections at intervals during copulation subsequently resolved the probable source and function of these pellets.

The female of a pair was dissected 30 minutes after copulation began. The bursa was then seen to be filled with a semifluid undifferentiated mass which contained no sperm. There were no sperm in the spermatheca. Another copulating female was examined after 40 minutes and sperm were seen near the inner tip of the mass, which now was definitely known to be a spermatophore. At this time some sperm had already moved into the spermatheca. Several females were dissected immediately following copulation. Each time the bursa was filled with a spongy mass, sperm were in the spermatheca as well as still swimming up the five mm. long sperm duct, and some were at the entrance of the sperm duct which is located (dorsally) at the extreme anterior end of the bursa.

Three hours after copulation the bursa is distended by the spermatophore. By this time the spermatophore is distinctly composed of an outer layer which fluoresces and an internal gelatine-like mass which does not fluoresce. Its general appearance is clearly that of the voided pellet. After 20 hours the *in situ* spermatophore is compressible and leathery in consistency. The voided spermatophore becomes hard within 30 minutes. Attempts were made to kill pairs *in copula* in order to establish the exact role of the male genitalia in sperm transfer and spermatophore formation. The technique used, however, did not accomplish the desired result. A study comparable to that of Blunck (1912), wherein serial sections of pairs of *Dytiscus marginalis* LeConte were made at intervals during copulation and the actual transfer of sperm and the construction of the spermatophore could easily be followed, is desirable.

Dissections of sexually mature males revealed that the accessory glands fluoresced brightly. It is of interest that in the body of the male each sperm travels about 34 mm. The testes and sperm from the spermatheca did not fluoresce nor did any organ or gland within the female.

It is apparent from the foregoing observations that the principal source of the spermatophore in *Chilocorus* is the accessory gland of the male. During copulation the glandular secretions enter the bursa of the female, expand, and consequently assume the general shape of the bursa. An outer layer becomes differen-

tiated as a semisolid and is referred to as the wall of the spermatophore. The exact nature of the nonfluorescent inner mass is not understood. It may be material previously secreted by the female and subsequently enveloped by the male's secretions during formation of the spermatophore. At any rate, it is believed that the sperm and associated fluids are ejected into the interior of the forming spermatophore.

Although the primary function, by definition, of the spermatophore is the transfer of sperm, it is thought that in *Chilocorus* other functions of importance are also performed. The swollen spermatophore and the attendant distension of the bursa could serve to prevent loss of sperm through migration away from the opening of the sperm duct.

Since the voided spermatophore has a definite pore at the anterior end, and since the pore is not apparent in the spermatophore *in situ*, it seems logical that the pore is formed by the sperm and associated fluids being forced through by the pressure of the swelling spermatophore upon its contents. The fact that the spermatophore when voided is empty (as is the bursa) suggests that the female either absorbs or voids its contents. The latter would be possible only after the spermatophore was passed.

Another possible function of the spermatophore is the preparation of the vaginal opening for oviposition. The passage of the spermatophore, by distending the opening, would allow the relatively free passage of the bulky eggs which follow.

The commonly observed low per cent of viable eggs deposited by *Chilocorus*, correlated with the need for repeated matings, is a probable result of a relatively inefficient fertilization mechanism.

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A NEW BIBIONIDAE FROM CALIFORNIA[1]

(Diptera)

D. ELMO HARDY

Hawaii Agricultural Experiment Station, Honolulu

One new species is on hand from the California Academy of Sciences collection which needs a name so that it might be included in my Bibionidae of California which is being published in the Bulletin of the California Insect Survey.

Bibio imparilis Hardy, new species

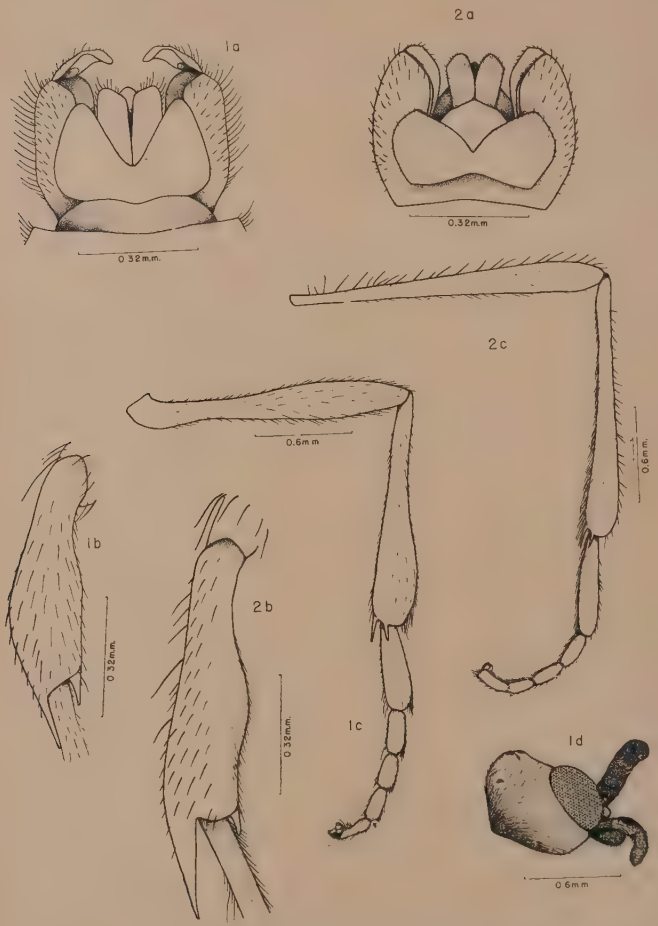
(figs. 1a–d)

This species fits rather closely to *B. townesi* Hardy but differs in many details. The hind femora, tibiae and basitarsi are not so slender, and the former two are not so long attenuated, compare figs. *1c* and *2c*. The male genitalia and the prothorax are entirely black, not predominantly yellow, and the genitalia are very different in development as shown in figs. *1a*. and *2a*. The antennae have only eight segments, counting the apical knob as two segments (fig. *1d*), not nine segments as in *townesi*. In both sexes, the costa extends distinctly beyond the apex of the radial sector, rather than extending at or near the apex. The coxae are brown to black, not yellow. The palpi are short with the segments not much longer than wide, rather than the palpi being elongate with the last two segments five or six times longer than wide. The females also differ by having the thorax and head predominantly black, not yellow.

Male.—Small, predominantly shining black species. *Head:* Antennae and palpi entirely dark brown to black, flagellum consisting of only five distinct segments, the large apical knob made up of two closely fused segments (fig. 1d). Palpi short, scarcely longer than lower division of compound eyes; apical segment slightly longer than wide; penultimate segment nearly two times longer than wide; second segment short, thick and flattened dorsally. Eyes rather densely covered with short, brown hairs; lower 2/5 of eye divided off into an area of smaller facets. *Thorax:* Shining black, except for the yellow humeral ridges and a faint tinge of rufous in ground color of the pleura and metanotum. Thoracic pile entirely yellow. Halteres dark brown, except for the yellow bases. *Legs:* Coxae and trochanters dark brown, remainder of legs yellow to rufous, except for last three segments of tarsi brown; apices of femora and tibiae tinged very lightly with brown. Front tibia shaped as in fig. 1b, inner spur short, scarcely one-quarter as long as outer. Hind femora and tibiae rather gradually tapered to bases, not strongly swollen apically. Hind tibia broader at apex

[1]Published with the approval of the Director of the Hawaii Agricultural Experiment Station as Technical Paper No. 441.

than the femur. Hind tarsal segments slightly swollen, basitarsus about three times longer than wide (fig. 1c). *Wings:* Faintly colored yellow-brown, anterior portion slightly darker. Costa extending distinctly beyond apex of radial sector; *rm* crossvein slightly longer than basal section of radial



Explanation of Figures

Fig. 1. *Bibio imparilis* Hardy. *a.* male genitalia, dorsal; *b.* front tibia; *c.* hind leg of male; *d.* head of female. Fig. 2. *Bibio townesi* Hardy. *a.* male genitalia, dorsal; *b.* front tibia; *c.* hind leg of male.

sector; posterior veins yellow-brown, distinctly darker than wing membrane; *m* crossvein and basal portion of vein M_{1+2} beyond the crossvein are very faint, almost obliterated. *Abdomen:* Entirely black, covered with yellow pile. Ninth tergum with a deep U-shaped cleft on hind margin, extending two-thirds the length of the segment (fig. 1a). Ninth sternum cleft on hind margin about one-half its length. Claspers simple, moderately slender and subacute at apices.

Length: Body, 4.5 mm.; wings, 5 mm.

Female.—Fitting the description of the male in most respects. Coxae tinged with rufous, humeral ridges and hind portions of propleura yellow. From a dorsal view, head nearly quadrate in shape. Front about equal to width of one eye, portion of head behind compound eyes about equal to length of one eye (fig. 1d). Hind tibiae not swollen at apices, tarsal segments slender. Abdomen dark brown, tinged with red; cerci yellow, tinged lightly with brown.

Length: Body, 4.75 mm.; wings, 5.5 mm.

Holotype male, allotype female and three paratypes, all males, from YOSEMITE VALLEY, MARIPOSA COUNTY, CALIFORNIA, May 21. 1921 (E. C. Van Dyke). Holotype, allotype, and one paratype in the California Academy of Sciences collection. One paratype each in the United States National Museum and the University of Hawaii.

LABORATORY MANUAL FOR INTRODUCTORY ENTOMOLOGY by Clifford J. Dennis. Wm. C. Brown Company, Dubuque, Iowa. Loose-leaf spiral binding. Price $2.00.

Dr. Dennis, who is Associate Professor of Biology at East Central State College, Ada, Oklahoma, has presented a brief and simple manual covering subdivisions of Entomology. The work opens with a chapter on collecting and techniques, followed by chapters on a comparison between insects and other arthropods, external anatomy, mouthparts, antennae, legs, wings and internal anatomy. Life cycles, insect groups, ecology and insect control make up the remaining chapters. There are two short appendices, dealing with materials and collection arrangements.

Techniques and structure are covered adequately for a course of these dimensions. I cannot help but feel that the other areas have been short-changed a bit. Of special note is the short shrift given basic systematics and nomenclature, early stages, behavior and the various practical disciplines to which entomology can be a valuable adjunct.

Strong points are the well-thought-out syllabus-like arrangement of the chapters, and the omission of unnecessary details, often left to clutter up a general course.

The manual seems to supply an adequate and reasonably priced guide to an introductory course in the subject, but would not be advisable for a more extended or technical approach.— J. W. TILDEN, *San Jose State College, San Jose, California.*

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE: NOTICE OF PROPOSED USE OF PLENARY POWERS IN CERTAIN CASES (A.[N.S.]42)

In accordance with a decision of the 13th International Congress of Zoology, 1948, public notice is hereby given of the possible use by the International Commission on Zoological Nomenclature of its plenary powers in connection with the following cases, full details of which will be found in *Bulletin of Zoological Nomenclature*, Vol. 17, Parts 1/2, published on 1 October, 1959:

(1) *Orthoceros* Brüunnich, 1771, and *Orthocera* Modeer, 1789, suppression of (Classes Foraminifera and Cephalopoda) (Z.N.[S.]44);

(2) *Orthoceratites* Lamarck, 1799, suppression of (Class Pelecypoda) (Z.N.[S.]1395);

(3) *Prothechus* and *Alloneura* Rondani, 1856, suppression of (Class Insecta, Order Diptera) (Z.N.[S.]230);

(4) *Beraea* Stephens, 1833, designation of type-species (Class Insecta, Order Trichoptera) (Z.N.[S.]395);

(5) *Apantania* Kolenati, 1847, designation of type-species (Class Insecta, Order Trichoptera) (Z.N.[S.]427);

(6) *Aphrophora* Germar, 1821, designation of type-species (Class Insecta, Order Hemiptera) (Z.N.[S.]478);

(7) *Drepanella*, validation of (Class Crustacea, Order Ostracoda) (Z.N.[S.]1112);

(8) *Westonoceras*, validation of (Class Cephalopoda) (Z.N.[S.]1226);

(9) *saccharivora* Peterkin, 1790 *(Phalaena)*, suppression of (Class Insecta, Order Lepidoptera) (Z.N.[S.]1315).

Any zoologist who wishes to comment on any of the above cases should do so in writing, and in duplicate, as soon as possible, and in any case before 1 March, 1960. Each comment should bear the reference number of the case in question. Comments received early enough will be published in the *Bulletin of Zoological Nomenclature*. Those received too late for publication will, if received before 1 March, 1960, be brought to the attention of the Commission at the time of commencement of voting.

All communications on the above subject should be addressed as follows: The Assistant Secretary, International Commission on Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London, S.W. 7, England.—RICHARD V. MELVILLE, *Assistant Secretary to the Internation Commission on Zoological Nomenclature.*

TAXONOMY OF NEOTROPICAL PSYCHODIDAE (DIPTERA) 1. PSYCHODA SPECIES OF WEST INDIES AND CENTRAL AMERICA WITH A KEY TO TRINIDAD SPECIES

Larry W. Quate
Bishop Museum, Honolulu

The recent acquisition of a large number of Neotropical moth flies has prompted the inception of a series of papers dealing with the taxonomy of the family from this region. It is anticipated that most of the study will be descriptions of new species and unlisted Neotropical records of previously described species. It appears likely that the geographic area will be largely the northern Neotropical region, although if specimens from other parts of the region become available they too will be included in the series.

The bulk of the specimens studied in the preparation of the present paper were received from Dr. T. H. G. Aitken of the Trinidad Regional Virus Laboratory, and sincere appreciation is extended to him for procuring the specimens. Nearly all the Trinidad (B.W.I.) records are based on Aitken's material. Gratitude is also expressed to Dr. Alan Stone for arranging the loan of relevant psychodid material from the U.S. National Museum, most of which is from the Canal Zone.

Psychoda ichthycerca Quate

Psychoda ichthycerca Quate, 1959, Insects of Micronesia (Bishop Museum), 12(4), in press.

Specimens examined: Trinidad: Tucker Valley, U.S. Naval Sta., VI-56, VII-6-56, X-26-56, XII-17-56, light trap, (Aitken).

Distribution: Micronesia, Trinidad.

Psychoda rarotongensis Satchell

Psychoda rarotongensis Satchell, 1953, Proc. Roy. Ent. Soc. London (B), 22:183; Quate, 1955, Univ. Calif. Publ. Ent., 10:208.

Psychoda lucia Quate, 1954, Proc. Hawaiian Ent. Soc., 15:349.

Specimens examined: Nicaragua: Rama, Zelaya, VII-20-43, (Woke), Costa Rica: Higuito, San Mateo, (Schild); San Pedro de Montes de Oca, X-32, (Ballou). Panama: Trinidad Rio, VI-9-12, (Busck); Tobago Isl., IX-30-26, *ex.* ripe fruit *Spondias lutea,* (Moline). Canal Zone: Ft. Clayton, II-2-56, light trap; Ft. Kobbe, IX-50, light trap; Barro Colorado Isl., XI-41, reared from *Calathea violacea;* Mojinga Swamp, I-9-53, light trap. Puerto Rico: El Semil, Villalba, V-30-42, (Hoffman). Trinidad: U.S. Naval Sta., (Aitken); Tucker Valley, U.S. Naval Sta., III-19-56, X-5-56, XI-9-56, XII-17-56; Chaguaramas, U.S. Naval Sta., II-27-56, V-21-56, VII-15-56, X-11-56, XII-28-56; Macqueripe, U.S. Naval Sta., II-25-56, VIII-17-56,

XI-9-56, XII-17-56; San Jose Point, U.S. Naval Sta., I-4-57, IX-27-56, XI-12-56.

Distribution: Solomon Is., Cook I., Micronesia, Hawaiian Is., U.S., Nicaragua, Costa Rica, Panama, West Indies.

This widespread species undoubtedly owes its extensive range to human dispersal and probably breeds in plant materials carried aboard ships. It was the most abundant species represented in the collections studied.

Psychoda cochlearia Satchell

Psychoda cochlearia Satchell, 1950, Proc. Roy. Ent. Soc. London, (B), 19:181 (descr., illus.); Quate, 1959, Insects of Micronesia (Bishop Mus.), 12(4), in press.

Specimens examined: Canal Zone: Ft. Kobbe, IX-50, light trap. Trinidad: Macqueripe, U.S. Naval Station, II-25-56, light trap, (Aitken); Tucker Valley, U.S. Naval Sta., VII-16-56, XII-17-56; Chaguaramas, U.S. Naval Sta., XII-28-56.

Distribution: Fiji, Micronesia, Canal Zone, Trinidad.

Psychoda zetoscota Quate, new species

(Figures 1, 2)

Female. *Head:* eyes separated by distance equal to one facet diameter; interocular suture absent; eye bridge with four rows of facets; frons with median band of hair extending posteriorly and nearly joining hair area of vertex: labellum with four teeth and two spines; palpus about one third the length of antenna, ratio of segments 4:5:5:7. Antenna with 15 segments, 14 and 15 separate, 15 about half the size of 14. *Wing:* Sc ending little before level of base of R_1; bases of R_3 and M_2 lacking. *Genitalia* as figured; subgenital plate subrectangular with moderate apical concavity; genital digit present.

Measurements: holotype, antenna 0.7 mm.; wing length 1.2 mm.; wing width 0.6 mm. Paratypes, wing length 1.1–1.3 mm.; wing width 0.5–0.6 mm.

Male unknown.

Holotype female (U.S. National Museum): Fort Claiton, Canal Zone, February 2, 1956, light trap. Paratypes, three females, same data. Other specimens: Trinidad; Tucker Valley, U.S. Naval Station, 27-VII-56, light trap, (Aitken).

Distribution: Canal Zone, Trinidad.

P. zetoscota is closely allied to the Formosan species *formosana* Tokunaga (1957, Sci. Rpt. Saikyo Univ. Agric., No. 9, p. 61) on the basis of the close similarity of the wing venation and female subgenital plate, but differs in that the antenna is 15-segmented and 16-segmented in *formosana*.

Psychoda platilobata Tokunaga

(Figures 3, 4, 5)

Psychoda platilobata Tokunaga, 1957, Sci. Rpt. Saikyo Univ. Agric., No. 9, p. 65.

Male. *Head:* eyes separated by distance equal to less than one facet diameter; interocular suture absent; eye bridge with four rows of facets; frons with median band of hair extending posteriorly and joining hair area of vertex; labellum with four teeth and two spines; palpus about one third the length of antenna, ratio of segments 4:4:5:6. Antenna broken (see female); all sensory filaments Y-shaped. *Wing:* Sc ending near level of base of R_5; veins R_5 and M_4 very heavy; longitudinal veins with brown spots at apices, spots may be faint and indistinct; ratio of R_{2+3}:R_2:R_3=7:6:9, ratio of M_{1+2}:M_1:M_2=6:12:10. *Genitalia* as figured; dististyle with several irregular rows of spines, paramere pointed with notch before apex.

Measurements: wing length 1.7 mm.; wing width 0.5 mm.

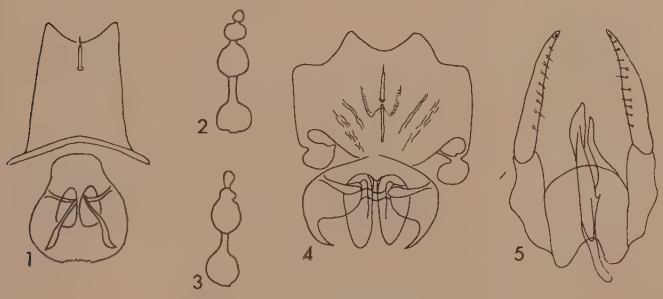
Female. Similar to male. *Head:* eyes separated by distance equal to one facet diameter. Antenna with 15 segments, 14 solidly fused to 13, 15 separate, about half the size of 14; 13 and 14 with tubercle-bearing spine. Sensory filaments dimorphic, those on third and fourth segments with three short arms, remainder Y-shaped. *Genitalia* as figured; subgenital plate heavily sclerotized, weakly bilobed.

Measurements: antenna 0.7–? mm.; wing length 1.2–1.6 mm.; wing width 0.5–0.6 mm.

Specimens examined: TRINIDAD: Tucker Valley, U.S. Naval Station, VI-56, VII-6-56, VIII-16-56, X-11-56, XI-1-56, XII-17-56. JAMAICA: Kingston, I-29-37, Sta. 361, (Chapin and Blackwelder).

Distribution: Trinidad, Jamaica, Formosa.

This common West Indian species may be recognized by the two heavy veins, R_5 and M_4, the spots at the tips of the veins, the genitalic structure of both sexes, but especially by



EXPLANATION OF FIGURES

Fig. 1. *Psychoda zetoscota* Quate, female genitalia. Fig. 2. *P. zetoscota* Quate, antenna tip, Fig. 3. *P. platilobata* Tokunaga, antenna tip. Fig. 4. *P. platilobata* Tokunaga, female genitalia. Fig. 5. *P. platilobata* Tokunaga, male genitalia, dorsal view.

the unusual subgenital plate of the female and the dimorphic antennal sensory filaments of the female.

In spite of the surprisingly discontinuous distribution of the species, there is little doubt that the Neotropical specimens are conspecific with the Formosan. The unusual features of the wing venation, antennal sensory filaments, and female subgenital plate are too similar to regard the specimens otherwise. (My drawing of the female subgenital plate differs from that of Tokunaga in outline because I have illustrated the internal shelf-like structure which apparently was lost in Tokunaga's dissection and gives the plate a more quadrangular appearance.)

Psychoda alternata Say

Psychoda alternata Say, 1824, Narr. exp. source St. Peter's River, 2:358; Quate, 1955, Univ. Calif. Publ. Ent., 10:218 (biblio., descr., and illus.).

Specimens examined: Mexico: Orizaba, I-3-08, (Knab); Cordoba, I-3-08, IV-1-08, XII-18-07, (Knab). Canal Zone: Ft. Kobbe, VIII-54, (Field); same, IX-50, light trap. Puerto Rico: Bayamon, I-21-34, (Anderson). Trinidad: Tucker Valley, U.S. Naval Station, III-19-56, VII-6-56, X-5-56, XI-9-56, light trap, (Aitken). Jamaica: Newport, II-20-37, (Chapin and Blackwelder).

Distribution: Cosmopolitan. Mexico, Canal Zone, Jamaica, Puerto Rico, Trinidad.

Psychoda alternicula Quate

Psychoda alternicula Quate, 1955, Univ. Calif. Publ. Ent., 10:222 (descr. and illus.).

Specimens examined: Mexico: Ciudad Valles, S.L. Potosi, XII-1-44, light trap, (Brookman). Canal Zone: Ft. Kobbe, IX-50, light trap. Trinidad: Tucker Valley, U.S. Naval Station, XII-7-56, light trap, (Aitken).

Distribution: U.S., Mexico, Canal Zone, Trinidad.

Psychoda lativentris Berdén

Psychoda lativentris Berdén, 1952, Opusc. Ent., 17:111; Quate, 1955, Univ. Calif. Publ. Ent., 10:217.

Specimens examined: Tlalnepantla, Mexico, XI-13-56, (Snow).

Distribution: Holarctic. Mexico.

This species is included here because it probably will be found in Central America. Most likely it will not show up in Trinidad, as the extensive light trap collections have failed to reveal it, and it is commonly taken at light in North America.

Psychoda gehrkeae Quate, new species

(Figures 6, 7)

Female. *Head:* eyes separated by distance equal to one facet diameter; interocular suture absent; eye bridge with four rows of facets; frons with median band of hair extending posteriorly and nearly joining hair area of vertex; labellum with four teeth and two spines; palpus about one-quarter the length of antenna, ratio of segments 5:5:5:5.5. Antenna with

16 segments, 14 and 15 partly fused, separated from 13; 16 separate, about one-half the size of 15; sensory filaments Y-shaped. *Wing:* Sc ending little beyond base of R_1; ratio of $R_{2+3}:R_2:R_3=8:7:10$; ratio of $M_{1+2}:M_1:M_2=7:14:12$. *Genitalia* as figured; subgenital plate with bulging sides and moderate apical concavity; genital digit long and slender.

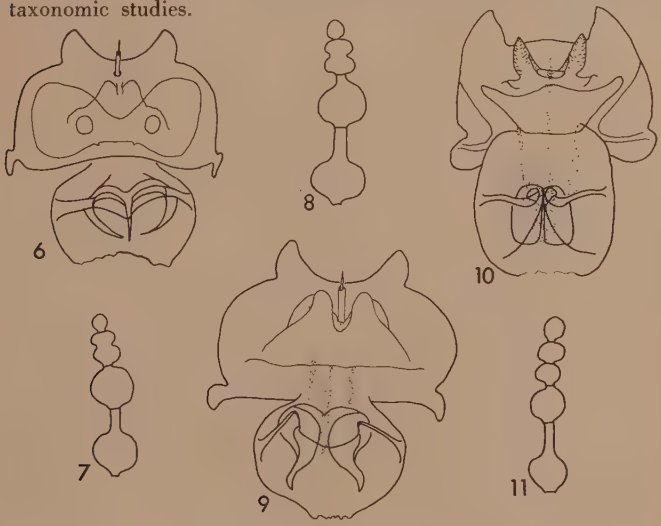
Measurements: holotype, antenna 0.8 mm.; wing length 1.3 mm.; wing width 0.5 mm. Paratypes, antenna 0.7–? mm.; wing length 1.3–1.6 mm.; wing width 0.5–0.6 mm.

Male unknown.

Holotype female (U.S. National Museum): TUCKER VALLEY, U.S. NAVAL STATION, TRINIDAD, November 19, 1956, light trap, (T. H. G. Aitken). Paratypes: four females, same data; one female, same data except VI-56; one female, same data except VII-16-56; one female, Macqueripe, U.S. Naval Station, Trinidad, VIII-2-56; one female, same data except XII-17-56.

Distribution: Trinidad.

This species is named in honor of Mrs. E. A. Gehrke in appreciation of her continued interest in and appreciation of taxonomic studies.



EXPLANATION OF FIGURES

Fig. 6. *Psychoda gehrkeae* Quate, female genitalia. Fig. 7. *P. gehrkeae* Quate, antenna tip. Fig. 8. *P. scotina* Quate, antenna tip. Fig. 9. *P. scotina* Quate, female genitalia. Fig. 10. *P. aitkeni* Quate, female genitalia. Fig. 11. *P. aitkeni* Quate, antenna tip.

Psychoda scotina Quate, new species

(Figures 8, 9)

Female. *Head:* eyes separated by distance equal to one facet diameter; interocular suture absent; eye bridge with four rows of facets; frons with median band of hair extending posteriorly to above level of center of eye bridge, almost joining hair area of vertex; labellum with four teeth and two spines; palpus short, about one-quarter the length of antenna, ratio of segments 6:5:5:6. Antenna with 16 segments; segments 14 and 15 partly fused together, 16 separate, smaller than preceding segments; sensory filaments Y-shaped. *Wing*: Sc ending beyond base of R_1; ratio of R_{2+3}:R_2:R_3=9:8:12, ratio of M_{1+2}:M_1:M_2=8:16:14. *Genitalia* as figured; apex of subgenital plate with two well defined lobes; genital digit long and slender.

Measurements: holotype, antenna broken; wing length 1.5 mm.; wing width 0.6 mm. Paratypes, antenna 0.8–0.9 mm.; wing length 1.3–1.5 mm.; wing width 0.5–0.6 mm.

Male unknown.

Holotype female (U.S. National Museum): FORT CLAITON, CANAL ZONE, February 2, 1956, light trap. Paratypes; 14 females, same data. Other specimens: TRINIDAD: Tucker Valley, U.S. Naval Station, VII-6-56, X-5-56, XII-17-56, light trap, (Aitken).

Distribution: Canal Zone, Trinidad.

Psychoda aitkeni Quate, new species

(Figures 10, 11)

Female. *Head:* eyes separated by distance equal to one facet diameter; interocular suture absent; eye bridge with four rows of facets; frons with median band of hair extending posteriorly to below level of center of eye bridge, not joining hair area of vertex; labellum with two spines; palpus about one-third the length of antenna, ratio of segments 5:7:7:9. Antenna with 16 segments, terminal three subequal in size, separated; sensory filaments Y-shaped. *Wing:* Sc ending before base of R_1; ratio of R_{2+3}:R_2:R_3=8:6:11, ratio of M_{1+2}:M_1:M_2=6:16:14. *Genitalia* as figured; apex of subgenital plate with rectangular concavity; V-shaped structure on internal face of plate; genital digit absent.

Measurements: holotype, antenna 0.8 mm.; wing length 1.4 mm.; wing width 0.6 mm. Paratypes, wing length 1.4–1.5 mm.; wing width 0.5–0.6 mm.

Male unknown.

Holotype female (U.S. National Museum): CHAGUARAMAS. U.S. NAVAL STATION, TRINIDAD, February 27, 1956, light trap. (T. H. G. Aitken). Paratypes, 10 females: Chaguaramas. U.S. Naval Station, Trinidad, VI-15-56, XI-9-56; Macqueripe, U.S. Naval Station. Trinidad, X-19-56; Tucker Valley, U.S. Naval Station, Trinidad, X-5-56, XI-9-56, XII-17-56. Other specimens: CANAL ZONE; Ft. Kobbe, IX-50, light trap; Ft. Claiton, II-2-56,

light trap; Mojinga Swamp, VII-15-52, light trap. PANAMA; Buena Vista, Transisthmian Hwy., Colon Prov., VIII-30-56, at light.

Distribution: Trinidad, Canal Zone, Panama.

Psychoda aitkeni is a common species in Trinidad and Panama occurring in quite large numbers in light trap collections. Only two other species of this area are more numerous in collections studied.

PSYCHODA PLAESIA Quate

Psychoda plaesia Quate, 1959, Insects of Micronesia (Bishop Museum), 12(4). In press.

Specimens examined: CANAL ZONE: Ft. Kobbe, IX-50, light trap.

Distribution: Canal Zone, Micronesia.

The wide distribution of this species is undoubtedly accounted for by rather recent dispersal by commercial transportation. Other species of the genus (e.g. *P. rarotongensis* Satchell) have a similar range.

KEY TO TRINIDAD SPECIES OF PSYCHODA

1. Bases of veins R_3 and M_2 lacking, bifurcations therefore incomplete....2
   Bases of veins R_3 and M_2 complete or only weakened at bifurcation.....3
2. Antennal segments 15 and 16 subequal in size.....*ichthycerca* Quate
   Antennal segment 15 about half the size of 16.....*zetoscota* Quate
3. Antenna with 14 or 15 segments.....4
   Antenna with 16 segments.....8
4. Antenna with 14 apparent segments (may actually be 15 but 14 greatly reduced and fused to 13).....5
   Antenna with 15 well defined segments.....6
5. Female subgenital plate hemispherical in general outline; aedeagus of male genitalia with small lateral shaft adjacent to main shaft near its center .....*rarotongensis* Satchell
   Female subgenital plate rectangular apically in general outline; aedeagus of male consisting only of simple main shaft.....*cochlearia* Satchell
6. Vein R_6 (vein ending in wing tip) not noticeably thicker than other veins; female subgenital plate with deep apical concavity.....7
   Vein R_6 definitely thicker than other veins; female subgenital plate with weak apical concavity.....*platilobata* Tokunaga
7. Female subgenital plate V-shaped, male aedeagus with lateral shaft straight and rounded at tip.....*alternata* Say
   Female subgenital plate Y-shaped; male aedeagus with lateral shaft curved and sharply pointed at tip.....*alternicula* Quate
8. Antenna segments 14 and 15 fused or partly fused together.....9
   Apical antennal segments clearly separated from each other.....10
9. Genital digit long, extending well beyond apex of subgenital plate; internal face of subgenital plate with pair of sac-like expansions marked with fenestra on either side of midline (male unknown)..*gehrkeae* Quate

Genital digit not extending beyond apex of subgenital plate; plate without sac-like lobes on internal face (male unknown) ..... *scotina* Quate

10. Female subgenital plate with large, rectangular apical concavity (male unknown) ..... *aitkeni* Quate

Female subgenital plate with very shallow apical concavity; male aedeagus with long, sickle-like lateral shaft, surstyle short and stocky, only little longer than dististyle ..... *plaesia* Quate

The following species have been recorded from the northern Neotropical region, but the brevity of the original descriptions and lack of specimens preclude their redescription and proper placement at the present time. (Williston's species are represented by single specimens only in the British Museum (Nat. Hist.) and unique type specimens, quite understandably, are not subject to loan.)

Psychoda angustipennis Williston, 1896, Trans. Ent. Soc. London, 1896:284. St. Vincent, Lesser Antilles. Type: Brit. Mus. (Nat. Hist.).

Psychoda antennalis Williston, 1896, Trans. Ent. So. London, 1896:283. St. Vincent. Type: Brit. Mus. (Nat. Hist.).

Psychoda atraseta Rapp, 1945, Jour. N.Y. Ent. Soc. 53:310. Barro Colorado I., Canal Zone. Type: Amer. Mus. Nat. Hist.

Psychoda brevitarsa Rapp, 1945, Jour. N.Y. Ent. Soc. 53:310. Barro Colorado I. Type: Amer. Mus. Nat. Hist.

Psychoda eburna Rapp, 1945, Jour. N.Y. Ent. Soc. 53:309. Barro Colorado I. Type: Amer. Mus. Nat. Hist.

Psychoda maculosa Rapp, 1945, Jour. N.Y. Ent. Soc. 53:309. Barro Colorado I. Type: Amer. Mus. Nat. Hist.

Psychoda pallens Williston, 1896, Trans. Ent. Soc. London, 1896:283. St. Vincent. Type: Brit. Mus. (Nat. Hist.).

Psychoda punctatella Townsend, 1897, Ann. Mag. Nat. Hist. ser. 6, 20:19. Vera Cruz, Mexico. Type: site unknown.

SUBTROPICAL FRUIT PESTS. By Walter Ebeling. vi + 436 pp. 160 black-and-white illus. 8 color plates. University of California Division of Agricultural Sciences. May, 1959. Price $7.00.

This complete reorganization and updating of Professor Ebeling's earlier work, "Subtropical Entomology," contains sections on control methods and materials, biology of citrus pests and biology of pests affecting non-citrus fruits. Separate chapters deal with citrus pests in the United States and in other countries, pests of avocado, grape, walnut, almond, pecan, olive, fig, date and minor subtropical fruits. Other topics include legislation and organizational controls, general artificial control, spray oils, fumigants, equipment and biological control. The book is intended for use as a reference work and practical guide for agricultural entomologists, chemical companies, pest control operators, agricultural extension workers, fruit growers, etc.—*Acting ed.*

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